Printed on Thin Paper for Foreign Circulation.

JAN 17 1924

# The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXVII.—No. 3549] LONDON: FRIDAY EVENING, JANUARY 4, 1924 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

Engineering Library

## PUBLIC NOTICES

**Hermitage Dam, Jamaica.**

TENDERS will be received at the office of the Colonial Secretary, Jamaica, for the CONSTRUCTION of a CYCLOPEAN MASONRY DAM and contingent WORKS required in connection with the extension of the Kingston and St. Andrews Waterworks.

Drawings can be seen and copies of the contract documents can be obtained at the office of the Crown Agents for the Colonies, 4, Millbank, London, S.W. 1, between the hours of 10 a.m. and 4 p.m.

Tenders must be addressed to the COLONIAL SECRETARY, Jamaica, British West Indies, so as to reach him not later than 1st March, 1924. 4498

**The Director-General,**

India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—

GIRDERS.

Tenders due on the 29th January, 1924.
Tender forms obtainable from above. 4502

**Board of Trade, Standards Department.**

A VACANCY exists for a CHIEF EXAMINER in the Standards Department of the Board of Trade, with establishment in H.M. Civil Service (subject to the production of the usual evidence as to fitness in respect of health and character) after two years' approved service. The duties are mainly the supervision of the examination of weighing and measuring apparatus of novel types with a view to their approval for use in trade.

Candidates, who must be British subjects by birth, and the sons of fathers also British subjects by birth, should preferably :—

(A) Be fully qualified in both physics and engineering and hold a first-class honours degree in at least one of these subjects ;
(B) Have had full workshop and drawing-office training ;
(C) Have had practical experience of construction and testing of weighing and measuring appliances or other similar apparatus ;
(D) Have been accustomed to conduct independent experimental investigations ;
(E) Have had administrative experience ;
(F) Be not less than 35 years of age ; and
(G) Be ex-Service men.

The salary is £400, rising by £15 to £500 per annum, with bonus on the Civil Service scale, which is re-assessed half-yearly on the basis of the average cost of living figure for the previous six months. The present annual bonus on £400 is £158, making a total initial remuneration at the present time £558 per annum. The next revision of bonus will take effect on the 1st March next.

Applications, with copies of testimonials, should be made in writing to the PRINCIPAL ESTABLISHMENT OFFICER, Board of Trade, Great George-street, Westminster, S.W. 1, by not later than the 17th January, 1924.

Applicants may be required to attend in London for interview and in that event to defray their own expenses. 4524

**Ministry of Transport.**

APPLICATIONS are INVITED for an APPOINTMENT as PERMANENT ASSISTANT ENGINEER in the Roads Department of the Ministry of Transport at a commencing salary of £200 per annum plus bonus, on the scale £200-£20-£500, plus bonus, which is subject to revision according to the cost of living index figure. The present bonus on £200 is £106 2s. per annum. Assistant Engineers are eligible for promotion to the class of Engineering Inspectors on the scale £600-£25-£800 plus bonus.

The selected candidate will be required to serve a two years' probationary period.

Candidates should be corporate members of the Institution of Civil Engineers or should hold some equivalent professional qualification. Experience of Road and Bridge Construction is essential, and experience in the service of Highway Authorities is an advantage. Candidates should be not more than 35 years of age and should have served in His Majesty's Forces.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1.

Applications can only be received on the recognised forms and should reach the Ministry of Transport on or before the 15th January, 1924. 4477

**The Institution of Civil Engineers.**

The Council of the Institution of Civil Engineers DESIRE to MAKE it KNOWN to the public that, under new By-laws approved and allowed by H.M. Privy Council, in accordance with the Supplemental Charter recently obtained, MEMBERS and ASSOCIATE MEMBERS of the Institution of Civil Engineers are, and are entitled to DESCRIBE THEMSELVES as, "CHARTERED CIVIL ENGINEERS." 4484

**Bengal-Nagpur Railway Company, Limited.**

The Directors are prepared to receive TENDERS for :
4000 LASHING CHAINS.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 28th December, 1923.

A fee of £1 will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Thursday, 10th January, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board.
E. C. VOLKERS,
4472 Secretary.

**Bengal-Nagpur Railway Company, Limited.**

The Directors are prepared to receive TENDERS for :
(A) LAMINATED BEARING SPRINGS.
(B) VACUUM BRAKE PIPE COUPLINGS.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 3rd January, 1924.

For each copy of the specification (A) a fee of 20s. will be charged, and for each copy of specification (B) a fee of 10s. will be charged, which fees are not returnable.

Tenders must be submitted not later than Noon on Monday, 14th January, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board.
E. C. VOLKERS,
4507 Secretary.

## The Engineer

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Progress of the Engineering Industries in 1923 :—

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Railways.
Locomotives.
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Electrical Engineering.
Sanitary Engineering.
Shipbuilding.
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## PUBLIC NOTICES

**Administrative County of London.**

ELTHAM SEWER.

The London County Council invites TENDERS for the CONSTRUCTION of an 8ft. internal diameter SEWER in BRICK and IRON of a total length of about 2¼ miles, with WEIR CHAMBER, SIDE ENTRANCES, MANHOLES, &c., in the Metropolitan Boroughs of Woolwich and Greenwich.

Persons desiring to submit Tenders may obtain, on and after Friday, 4th January, 1924, the form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £10. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after Twelve Noon on Tuesday, 29th January, 1924, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
4491 Clerk of the London County Council.

**Borough of Falmouth.**

The Corporation of Falmouth are prepared to receive TENDERS for the LAYING of 4340 FEET of CONCRETE TUBES, 21in. in diameter, together with MANHOLES and other APPURTENANCES. Also for the CONSTRUCTION of a STORAGE TANK, 75ft. long, constructed largely in rock tunnel, together with a PENSTOCK CHAMBER, VALVE HOUSE and a CAST IRON SEA OUTFALL carried to low-water mark of spring tides in the rocky foreshore at or near to Middle Point.

Plans can be seen and the specification, bill of quantities, form of Tender, and draft contract obtained at the Borough Surveyor's Office, Falmouth, or at the offices of the Engineer, Mr. G. Midgley Taylor, Messrs. John Taylor and Sons, 36, Victoria-street, Westminster, S.W. 1, on or after Wednesday, January 9th, 1924, upon payment of £5 5s. by cheque, which will be returned on receipt of a bona fide Tender on the form supplied.

As the works are for the relief of the unemployed, the contract will be subject to the special conditions laid down by the Unemployment Grants Committee, and the works must be in active progress by the first day of February, 1924.

Tenders, sealed and endorsed "Tender for Sewer, Storage Tank, and Sea Outfall," to be sent to the undersigned on or before Noon, Saturday, the 19th January, 1924.

The Corporation will not be bound to accept the lowest or any Tender.

W. H. LUPTON,
Town Clerk.
Municipal Offices, Falmouth. 4504

**City of Hull Water and Gas Department.**

TO PIPE FOUNDERS.

The Corporation are prepared to receive TENDERS, from British manufacturers, for about 3000 TONS of 24in., 25in., and 36in. CAST IRON PIPES and SPECIALS.

Copies of specification and forms of Tender may be obtained of the undersigned.

Tenders, endorsed "Tenders for Cast Iron Pipes and Specials," are to be addressed to the Chairman of the Water and Gas Committee, and delivered at the Town Clerk's Office not later than first post on Monday, the 14th January, 1924.

By order,
C. B. NEWTON, M. Inst. C.E.,
City Water and Gas Engineer.
Hull, January, 1924. 4480

## PUBLIC NOTICES

**Clyde Navigation.**

DOCK NO. 1, SHIELDHALL, GLASGOW HARBOUR.

The Trustees of the Clyde Navigation invite TENDERS for the CONSTRUCTION of about 1928 LINEAL YARDS of CONCRETE QUAY WALL forming Dock No. 1, Shieldhall, Glasgow Harbour, to be founded partly on a substructure of concrete monoliths and partly in open piled trench.

The specification and schedule and form of Tender can be obtained at the Engineer's office here on and after Friday, 4th January, on payment of a deposit of £10, which will be returned on receipt of a bona fide Tender.

An assistant engineer will meet intending offerers on Monday, 7th January, at 11 a.m., at Maxwell-road, Shieldhall, to point out the situation of the works, and consequently as may be required.

Sealed Tenders, marked "Tender for Dock No. 1, Shieldhall," are to be lodged with the undersigned not later than Noon of Monday, 28th January next.

The lowest or any Tender may not be accepted.

T. F. H. MACKENZIE,
General Manager and Secretary.
16, Robertson-street, Glasgow,
28th December, 1923. 4479

**County Borough of Preston.**

ELECTRICITY DEPARTMENT.

The Electricity Committee invite OFFERS for the PURCHASE and REMOVAL of the undermentioned STEAM ENGINES and DYNAMOS, which may be inspected at the Crown-street Power Station, Preston :—

ONE Belliss and Morcom TRIPLE-EXPANSION ENGINE, 450 r.p.m., 390 B.H.P., coupled to TWO D.C. DYNAMOS, each 225/240 volts, 420 amperes, by Electric Construction Co., Ltd.
ONE William and Rostron TRIPLE-EXPANSION ENGINE, 270 r.p.m., 825 B.H.P., coupled to ONE 500 a.c. D.C. DYNAMO, 440/500 volts, 1020 amperes, by Electric Construction Co., Ltd.
ONE SURFACE CONDENSER, with AIR PUMP, &c.

Further particulars on application to the BOROUGH ELECTRICAL ENGINEER, 11a, Fishergate, Preston. 4485

**Metropolitan Borough of Hammersmith.**

ELECTRICITY DEPARTMENT.
TO MAKERS OF COAL DRYERS.
PRICES AND PARTICULARS REQUIRED FOR
COAL DRYING APPARATUS,
capable of dealing with about 10/15 tons per hour.—Send details to C. G. BELL, Borough Electrical Engineer, Electricity Works, 35, Fulham Palace-road, W. 6. 4489

TO BOILERMAKERS AND OTHERS.

**Tenders are Invited for the PROVISION and INSTALLATION of a LANCASHIRE BOILER,** 22ft. long by 7ft. diameter, for 120 lb. working pressure, in accordance with the specification prepared by Messrs. Edwards and Shaw, Consulting Engineers, 105, Colmore-row, Birmingham.

Copies of the specification and plans may be obtained from the Clerk to the Guardians, Union Offices, Pontypool, upon deposit of Three Guineas, which sum will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Boiler Tender," must be in the hands of the undersigned not later than 10 a.m. on Monday, January 21st, 1924.

The Guardians do not bind themselves to accept the lowest or any Tender.

The Guardians would consider an offer for a Government surplus boiler, or second-hand boiler of above dimensions, in first-class condition, delivered and erected.

T. P. H. WATKINS,
Clerk to the Guardians.
Union Offices, Pontypool. 4510

## PUBLIC NOTICES

**Croydon Union.**

STEAM COOKING APPARATUS.

The Guardians invite TENDERS for the SUPPLY and INSTALLATION at their Mayday-road Hospital of (a) ONE DOUBLE-DECK DRAWPLATE STEAM PIPE OVEN in brickwork, and (b) TWO SEPARATE VEGETABLE STEAMERS or ONE DOUBLE STEAMER.

Specification and other details in each case may be obtained on application to the Steward of the Hospital, Mayday-road, Thornton Heath.

Tenders, in envelope, sealed and endorsed, must be sent to the undersigned by or before 21st January, 1924.

NORMAN P. WALKER,
Clerk to the Guardians.
Union Offices, Mayday-road,
Thornton Heath, Surrey.
2nd January, 1924. 4531

**Port of Bristol.**

FLOATING PNEUMATIC ELEVATOR.

The Docks Committee are prepared to receive TENDERS for the CONSTRUCTION of a FLOATING PNEUMATIC GRAIN ELEVATOR to handle 150 tons per hour, erected at the Avonmouth Docks, Bristol.

On and after Monday, the 7th day of January, 1924, a copy of the form of Tender, general conditions, specification, schedule of prices, and a copy of the contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid to the Bristol Docks Committee, 19, Queen-square, Bristol, to whom all cheques must be made payable. The deposit of £5 will be returned hereafter to all bona fide tenderers.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Floating Pneumatic Elevator," and addressed to the General Manager and Secretary of the Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 18th day of February, 1924.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE,
Engineer.
Port of Bristol,
Chief Engineer's Office,
Avonmouth Docks,
1st January, 1924. 4511

**State Electricity Commission of Victoria.**

MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 24/4.—4 ONLY
100 K.V.A., 25,400-6600 V. TRANSFORMERS AND SPARES.

CHARGE.—10s. for the first two copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 5s. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £10 is to be lodged with Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 11th February, 1924.

E. LIDDELOW,
4501 Secretary.

**State Railways of Victoria, Australia.**

ASSISTANT CHIEF ELECTRICAL ENGINEER.

APPLICATIONS are INVITED by the Victorian Railways Commissioners for the above POSITION.

Salary £1000 per annum.

Applicants must pass medical examination.

Applicants must be capable of successfully handling all engineering and operating matters connected with railways, electrical systems, projecting proposals, alterations and extensions ; also erection and maintenance of electric power and lighting installations throughout railways.

Applicants should give full name, age, place of birth, details of engineering and administrative qualifications and practical experience on electrical railways and copies of references.

Applications, in sealed envelopes, marked "Application for position Assistant Chief Electrical Engineer," should be addressed to the Secretary, Victorian State Railways, Melbourne, Australia, direct, and must reach him on or before 31st March, 1924.

On behalf of the Victorian Railways Commissioners,

JOHN McWHAE,
Agent-General for Victoria (Australia),
Victoria House, Melbourne-place,
4520 Strand, London, W.C. 2.

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## PUBLIC NOTICES

### County of London.

The London County Council invites TENDERS for the SUPPLY, DELIVERY, and ERECTION of THREE 2000 K.W. ROTARY CONVERTERS, STATIC TRANSFORMERS, and ACCESSORIES.

The specification, form of Tender, and general conditions may be obtained from the General Manager, London County Council Tramways, Victoria Embankment, W.C. 2, upon payment of a deposit of £2. This amount will be returnable only if a bona fide Tender is submitted and not withdrawn.

Particulars of the work may be obtained at the Tramway Offices, Victoria Embankment, before payment of the deposit.

Tenders must be delivered to the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 21st January, 1924. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest ordinary Tender.

JAMES BIRD,
4467 Clerk of the London County Council.

### County of London.

DOWNHAM HOUSING ESTATE DEVELOPMENT.

The London County Council invites TENDERS for the DEVELOPMENT of a portion of its new DOWNHAM HOUSING ESTATE at Grove Park, Lewisham, S.E.

The work comprises generally :—

(1) Construction of Roads, Sewers, and other Works.

(2) The Erection of Houses and such other Buildings as may be determined.

TENDERS are INVITED on two alternative bases :

(A) On the basis of the Council bearing the actual cost of and financing the undertaking and paying a fee or commission to the contractor for his services, the amount of such fee or commission being dependent partly upon a comparison of cost with a predetermined value.

(B) On the basis of the contractor being paid at agreed rates or prices for all the work.

The Council has caused to be prepared certain drawings, specifications, bills of quantities, and a schedule of prices for a portion of the work. The bills of quantities (which relate to the houses) have been priced text and such priced bills, together with the schedule of prices (which relates to the road, sewer, and stream work), will form the foundation of Tenders, tenderers being requested to quote for such percentage variation thereto as they may consider necessary.

Two alternative Tenders must be submitted ; that is to say, under basis "A" above, which will apply to such number of houses (up to about 2000) and other buildings as the Council may require, together with the necessary road, sewer, and other work therefor, and under basis "B" above for approximately 500 houses, together with the roads and sewers necessary for such 500 houses.

Tenderers will be given the opportunity to submit, if desired, additional Tenders under basis "B" for approximately 1000, 1500, and 2000 houses, with the road, sewer, and other work necessary for each such number respectively.

The work will be carried out under the provisions of the Housing Acts, 1890 to 1923, and rapid execution of the work is necessary.

The stipulated time for completion in the event of 2000 houses being required is two years.

Tenders will be considered only from firms who are prepared and can show themselves able to undertake the organisation and completion of a large scheme.

The Council has resolved that, save in exceptional circumstances, all firms with whom the Council enters into contracts and to whom the conditions for membership of the King's National Roll are applicable, must be on the King's Roll.

Persons desiring to submit Tenders may obtain, on and after Monday, 7th January, 1924, the forms of Tender on application to the Administrator of Housing Development Schemes, at the Old County Hall, Spring-gardens, S.W. 1 (where drawings also can be inspected), upon payment of the sum of £10 (Ten Pounds). This amount will be returnable only if the tenderer shall have sent in bona fide Tenders and shall not have withdrawn the same.

Tenders must be delivered not later than 4 p.m. on Monday, 28th January, 1924, in the envelope provided, marked "Tenders for the Development of Downham," to the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the Council.

The County Hall,
Westminster Bridge, S.E. 1.
1st January, 1924. 4500

### County of London.

ROEHAMPTON HOUSING ESTATE. ROADS AND FOOTWAYS.

The London County Council invites TENDERS for the COMPLETION of the CARRIAGE-WAYS and FOOTWAYS of certain roads on the Roehampton Housing Estate, Putney, in the Metropolitan Borough of Wandsworth, comprising surfacing carriage-ways with tarred slag macadam, paving footways with artificial stone and other work.

Persons desiring to submit Tenders may obtain, on and after Monday, 7th January, 1924, the form of Tender, &c., on application to the Administrator of Housing Development Schemes, at the Old County Hall, Spring-gardens, S.W. 1, where a drawing also can be inspected, upon payment of the sum of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same.

No Tender received at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 28th January, 1924, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.

The County Hall,
Westminster Bridge, S.E. 1.
1st January, 1924. 4501

### The Madras and Southern Mahratta Railway Company, Ltd.

The Directors are prepared to receive TENDERS for :
12 BOGIE CARRIAGE UNDERFRAMES, I.R.C.A. STANDARD TYPE (BROAD GAUGE),
in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned. Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 22nd January, 1924, and marked "Tender for Underframes."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1.
28th December, 1923. 4482

### County Borough of Swansea.

MAIN DRAINAGE DEPARTMENT.

FIRST and SECOND CIVIL ENGINEERING ASSISTANTS REQUIRED for Main Drainage Scheme, involving Pumping Stations, Tunnelling Work, and Sea Outfall. Probable duration of scheme 10 years.

Applicants must state the post applied for and their experience, particularly in respect to the general design, preparation of detail working drawings, quantities, &c., of the above works, and of ferro-concrete work. Experience on the construction of works will be an advantage.

Salaries £400 and £350 per annum respectively.

Applications, stating age, qualifications, and full experience, together with copies of three testimonials, preferably from engineers under whom the applicant has served, to be forwarded to Mr. J. Richard Heath, Chief Engineer, Main Drainage Scheme, Guildhall, Swansea, on or before the 19th January, 1924. Envelopes to be endorsed "Main Drainage" (First or Second Engineering Assistant).

H. LANG-COATH,
Town Clerk.

Guildhall, Swansea,
20th December, 1923. 4476

## PUBLIC NOTICES.

### The Great Indian Peninsula Railway Company,

42, Copthall-avenue, London, E.C. 2, invite TENDERS for :—

| | Per. |
|---|---|
| 1. MISCELLANEOUS ARTICLES AND MATERIALS | 7s. 6d. |
| 2. CARRIAGE DOOR HANDLES, HINGES, BOLTS, &c. | 5s. |
| 3. W.I. TIE BARS FOR C.I. POT SLEEPERS | 5s. |
| 4. STEEL FISH-PLATES | £1 |
| 5. STEEL FISH-BOLTS | 10s. |

Tenders are due by 11 a.m. on 15th January, 1924. Tender forms obtainable at above address. Fees not returnable. 4523

### Civil Service of Canada.

WOOD PRESERVATION SPECIALIST. 3700 dollars per annum. Forest Products Laboratories, Forestry Branch, Department of the Interior, Montreal, Canada.

Full particulars and application forms furnished on application to the SECRETARY, High Commissioner for Canada, Kinnaird House, Pall Mall East, London, S.W. 1, England.

Applications should be filed with the SECRETARY of the CIVIL SERVICE COMMISSION, Ottawa, Canada, not later than March 1st, 1924. 4478

### Wilts County Council : Land Drainage Committee.

ASSISTANT LAND DRAINAGE SURVEYOR REQUIRED, to assist in the management of land drainage schemes (the improvement of rivers and streams) in connection with the relief of unemployment. The person appointed should be able to reference land, interview owners, take levels, prepare plans and sections, and must be able to organise and control labour. Preference will be given to an ex-Service R.E. and motor cyclist. The appointment is of a temporary nature, subject to one week's notice, at a salary of £5 per week with travelling expenses.

Applications, together with copies of testimonials, should be sent in at once to WHITFIELD, County Drainage Surveyor, Polebarn House, Trowbridge, Wilts. 4474

## SITUATIONS OPEN

WANTED by a Well-known Firm, the SERVICES of an experienced ENGINEER or FIRM, to act as REPRESENTATIVE in the Newcastle area and North-East Coast generally. Must be well connected with the leading collieries, steel works, &c.—Address applications, with full particulars of firms at present represented and qualification generally, 4520, The Engineer Office. 4520 A

WANTED FOR CANADA.—
Large Firm of TAR DISTILLERS, with works situated at various points in Canada, will shortly REQUIRE a GENERAL SUPERINTENDENT, to be responsible for works operations and maintenance. Applicants should hold a good degree from a British University of standing, preferably in engineering, but must also have a sound chemical knowledge. Considerable previous works experience essential. Great importance is attached to applicant's personality and to his ability to command men.—Reply in writing, stating salary required, &c., 4508, The Engineer Office. 4508 A

WANTED, Energetic MAN, to Take Charge of Water Mains in country district. Inspect Services, Fittings, and Mains for leakage, Read Meters, &c. Give age, particulars of all previous experience, and wages required. Free house provided.—Address, 4517, The Engineer Office. 4517 A

WANTED IMMEDIATELY, Young ENGINEER, with thorough knowledge of Brickworks and Quarry Machinery.—Address, stating full particulars of experience, salary, age, &c., P8481, The Engineer Office. P8481 A

WANTED, MAN, with Combined Engineering and commercial experience, to Take Charge of Estimating and Sales Departments of a General Engineering Works in North of England. First-class references required. Age not less than 35. Preference to public school man.—Address, enclosing photo, stating age, experience, and salary required, P8475, The Engineer Office. P8475 A

ASSISTANT MANAGER WANTED for Marine Engineering Works in China. Applicants must possess thorough technical and also practical knowledge of Modern Marine Engineering. Age 25 to 40. Salary commencing £750.—Address, detailing experience and qualifications for the post, P8480, The Engineer Office. P8480 A

CONSTRUCTIONAL ENGINEERS in London REQUIRE SERVICES of an ASSISTANT to Works Foreman.—Address, stating age, experience, and salary required, P8461, The Engineer Office. P8461 A

REINFORCED CONCRETE or STRUCTURAL STEEL WORK DRAUGHTSMAN REQUIRED, aged about 21.—Address, P8497, The Engineer Office. P8497 A

WELL-TRAINED and Experienced ENGINEER REQUIRED, to Take Sole Charge of the Design and Manufacturing Departments of Firm of Industrial Gas Heating and Lighting Specialists. Applicants must possess specialised knowledge of the application of both town and producer gas to all industrial heating problems.—Address, stating qualifications and salary required, 4528, The Engineer Office. 4528 A

£750 TO £1000 A YEAR to the Right Man.—An old-established FIRM of METAL WINDOW MAKERS REQUIRE a thoroughly competent MAN with experience in the trade and a sound connection amongst the chief London architects and contractors, to REORGANISE their LONDON OFFICE on a salary and commission basis. Replies, which will be treated in the strictest confidence, should state age, experience, present capacity, and whether married or single.—They should be sent in the first case to P8478, The Engineer Office. P8478 A

WANTED, CHIEF DRAUGHTSMAN for Engineering Company manufacturing Crushing, Conveying, Elevating Machinery, &c. Some Electrical knowledge desirable.—Address, giving references, previous experience, age and salary expected, 4496, The Engineer Office. 4496 A

WANTED, TWO First-class DRAUGHTSMEN for the North of England, one experienced in the Design of Steam and Electrically Driven Winders, also one experienced in the Design of Machinery for Cement Works, Crushing and Screening Plants and the Lay-out of same.—Address, stating details of past experience, age and salary expected, 4490, The Engineer Office. 4490 A

CHIEF DRAUGHTSMAN WANTED for Works Near London, manufacturing high-class machinery. Must have good experience of modern office methods and economic production and have tact in handling personnel. Knowledge of Refrigeration desirable. State salary expected, age, and experience.—Address, 4515, The Engineer Office. 4515 A

DRAUGHTSMAN REQUIRED for Well-known Eastern Counties Engineers ; must be thoroughly experienced and capable designing all classes of Electric Cranes. Must be quick and accurate.—State age, experience, salary required, and when at liberty, to "TITAN," c/o Davies and Co., 95, Bishopsgate, E.C. 2. 4503 A

DRAUGHTSMAN REQUIRED. Thoroughly Competent, with general mechanical and structural experience in the Design and Lay-out of Steel Works Plant.—Applications are invited from first-class men only and should state age, experience in full, and salary required, and be addressed to STEIN and ATKINSON, Ltd., 47, Victoria-street, London, S.W. 1. 4504 A

## SITUATIONS OPEN (continued)

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**For continuation of Small Advertisements see page 3.**

JANUARY 4, 1924.—VOL. CXXXVII.

# THE ENGINEER.

## *A Seven-Day Journal*

### A Broadcasting Achievement.

ON Friday and Saturday nights of last week the British Broadcasting Company succeeded in transmitting through all its stations a portion of the programme sent out by the East Pittsburg station in such a way as to make it distinctly audible even to the owners of small crystal sets. The American programme, sent out on a 100 m. wave length, was received at a temporary station erected at Biggin Hill Aerodrome on the North Downs of Kent. The apparatus used consisted of a cage type aerial on a 60ft. pole and a receiving set having six high and two low-frequency valves and a detector valve. From Biggin Hill the programme was relayed to London and thence transmitted throughout the company's system. The reception was generally good, although at times heavy atmospherics interfered with it. The experiment, it is intimated, will be repeated in a short time after certain alterations in the aerial and other parts of the primary receiving apparatus have been made.

### The Imperial Air Transport Company.

THE agreement governing the establishment of the Imperial Air Transport Company, Limited, has now been signed by the Air Minister on the one hand, and the British, Foreign and Colonial Corporation on the other. Its terms, published last Friday, follow in general the recommendations of the Civil Air Transport Subsidies Committee. Some of the details, however, are of fresh interest. The field of operation of the Imperial Air Transport Company is to be restricted to Europe, including the Mediterranean and the Black Sea. The company is to acquire the businesses at present carried on by the Handley Page, Instone, Daimler and British Marine Companies, or, in default of such acquisition, is to establish an air transport system of its own to operate equivalent services. It is specified that all the directors and shareholders of the company shall be British subjects. The mileage to be flown per year has been agreed to on a somewhat curious basis. During the first four years the minimum per year is to be 800,000 miles, although the average minimum over the four years must be 1,000,000. During the remaining six years the yearly minimum is to be 1,000,000 miles. It appears from these figures that the relief granted during the earlier years is a two-edged sword, for if the company succeeds in performing but 800,000 miles in, say, the first and second year, it will need to do 1,200,000 miles in the third and fourth, while in the fifth it will be permissible for it to slacken off to 1,000,000 miles. The subsidies to be paid are subject to reduction in the event of the minimum mileages not being completed. Without any deductions of this nature they will range from £137,000 per annum in the first four years to £32,000 in the tenth year. The company is to undertake experimental work for the Government at net cost, and is not, without consent, to manufacture aircraft or aero-engines or hold shares in any company so engaged. All the machines, engines and accessories used by the company are to be of British design and manufacture and all repairs, so far as possible, are to be done on British territory. The company's aircraft, aerodromes and bases are to be placed at the disposal of the Government in any national emergency.

### Vickers and Pulverised Coal.

THE announcement is made that a new company has been registered under the title Vickers and International Combustion Engineering, Limited, with a capital of £500,000. This cumbersome designation covers a combination of interests which is the outcome of several months of negotiations between Vickers, Limited, and the International Combustion Engineering Corporation of New York, which two undertakings are to hold the capital of the new company in equal proportions. The International Corporation, as our readers must already know, has been responsible for the development and application of the "Lopulco" patented system of firing steam boilers with pulverised coal, notable examples of which are now to be found at work at the Milwaukee Electric Power Station and the Ford Motor Works. The new company is to manufacture at its own works at Barrow-in-Furness pulverised coal fired boilers, superheaters, economisers, impact pulverisers of the Raymond type, dryers, air heaters and all other auxiliary apparatus required in the equipment of power plants. The directors of the new company are Sir A. T. Dawson, of Vickers, Limited; Mr. G. R. T. Taylor, of Taylor Bros. and Co., Limited; and Messrs. G. E. Learnard and W. R. Wood, the president and vice-president respectively of the International Corporation.

### To Belfast *via* Holyhead.

THE deepening of the inner harbour at Holyhead, to allow the traffic to and from the Kingstown mail boats to be transhipped at Holyhead Station instead of at the Admiralty Pier, was commenced over two years ago and is now completed. It is stated that one result of this work is to be the institution of a fast service between Holyhead and Belfast. We cannot, however, quite see what purpose these new facilities are to serve. The London, Midland and Scottish already has its own through rail and steamer services to Belfast *viâ* Fleetwood, Heysham and Stranraer; also *viâ* Greenore and the Great Northern of Ireland and by the Belfast Steamship Company through Liverpool. Fleetwood, moreover, is half-an-hour nearer Euston than is Holyhead. On the other hand, boats are much sooner out to sea at Holyhead than they are through the rather circuitous path of the river Wyre at Fleetwood. A factor in favour of Holyhead is that it is a greater mail route than any one of the others, and it is possible that therein lies the reason for the new service. Mails for Belfast and the North of Ireland that go *viâ* Fleetwood for first delivery in the morning, leave Euston at 5.20 p.m.; those *viâ* Stranraer go on the "Postal" at 8.30 p.m., but do not reach Belfast until 9.30 a.m. The majority of the mails are sent by the Irish Mail at 8.45 p.m., and go *viâ* Kingstown and the Great Northern of Ireland, and are due in Belfast at 9.5 a.m. A new service from Holyhead, doing the sea journey in 5½ hours, would bring the mails and passengers into Belfast by 8.30 a.m. with only one transhipment, instead of one at Holyhead and another at Kingstown.

### A Goods Train out of Control.

NOT since the accident at Accrington on July 17th, 1913, has a case of a goods train being out of control on what was the Lancashire and Yorkshire system been reported upon by the inspecting officers of railways. There was, however, such a case on August 17th last, as to which Lieut.-Colonel Mount has just reported. This, too, was in the Accrington direction and on the same line, but it was to an up and not a down train, and on the south side and not the north side of the summit of this particular bank. The train had a load of 610 tons, and was within 30 tons of the maximum. It was assisted up the bank on the Accrington side by an engine in the rear, and the initial mistake was made by the driver of that engine who, whilst having acted as banking engine driver for a month, had only assisted to the actual summit on two or three occasions. That his knowledge of the surroundings was limited, was shown by his statement that he thought the summit was a train's length beyond the starting signal for Baxenden Colliery box. It was left to the discretion of the drivers concerned whether, or not, they should stop at the summit to pin down wagon brakes, and the driver of this train intended to do so. As a result, however, of the banking engine driver's want of knowledge the train was pushed over the summit and the train driver could not stop. It is doubtful whether he subsequently recognised that his train was out of control. He said that he kept whistling, but no one heard any whistles until he was 1¾ miles from Ramsbottom. At that place there is a road level crossing and the gates were open for the roadway. Had earlier intimation been sent of the train being out of control—which would have been done had the whistles been given—the crossing would have been cleared and the train allowed to proceed on its way and, having reached less severe gradients, been pulled up. Instead, it had to be allowed to run into a siding, where it destroyed seven standing wagons and did considerable damage to itself. The railway company's own rules provide that on gradients steeper than 1 in 65 the drivers have no discretion as to stopping, but must make a definite stop. As the gradient on the south side of the bank is 1 in 63, the officials were breaking their own rules in not scheduling this place for an absolute stop. It seems, however, that the gradient board at the summit showed "1 in 76," which was the average gradient for the bank. Perhaps this fact accounts for the omission referred to.

### The Airship Dixmude.

THE mysterious disappearance of the French airship Dixmude, with officers, passengers and crew numbering about fifty, is one of the most tragic occurrences in the history of the rigid dirigible. The only evidence of its fate is the finding of the commander's body in the sea off the southernmost point of Sicily. The Dixmude was the last of the big and powerful war-time dirigibles constructed by the Zeppelin Company, and was surrendered to France, with two smaller commercial airships, in 1920. It was handed over to the Naval Department in the following year and taken to Cuers, near Toulon. It was not until a few months ago that the Dixmude was put into active service, its first long journey being one of 118 hours, when it made a cruise to the South of Algeria. It took part in the Mediterranean manœuvres in November, when it was found that the crew needed further training, and for that purpose the airship started on December 18th for a voyage of 78 hours, when it was to have crossed over to North Africa and engage in reconnaissance work. The course taken by the airship appears to be uncertain, but it is supposed that the Dixmude proceeded to the desert as far as Insalah and, when returning by the Gulf of Gabes to Sicily, was caught in the path of a violent storm. This disaster, following upon so many others, has considerably strengthened the opposition in France to big rigid airships. It shows once more the necessity of great caution in employing a type of aircraft which, while capable of rendering valuable service, can only be safely handled by a highly trained staff and under conditions that will ensure its always being navigated in fair weather.

### New South Wales Railways.

FOR reasons that we have not seen stated, the Government of New South Wales announced last September that two railway experts—one on operation and one on engineering—were to be appointed to inquire into the working of the railways in that State. We believe that Mr. Wedgwood, chief general manager of the London and North-Eastern Railway, was requested to select the desired experts, and it is now announced that Sir Sam Fay and Sir Vincent Raven have been chosen and that they will leave for Sydney in March. It must not be supposed that the appointment of these gentlemen is any reflection on the ability of the administrative officers. The railways of New South Wales have, in the past, been served by such capable railway officers as the late Mr. E. M. G. Eddy and Mr. T. R. Johnson. The latter's return to England is so recent that the benefits of his control cannot have been dissipated, especially as Mr. Fraser, the present Chief Commissioner of Railways, was Chief Engineer under Mr. Johnson—himself a civil engineer. The influence of politics, where railways are State-owned, must not be forgotten. It affects their administration in many ways, and one of the evils is that they often become subjects of dispute between the parties. Nevertheless, the New South Wales railways cannot but benefit from a visit from such a practical railwayman as Sir Sam Fay and so eminent an engineer as Sir Vincent Raven.

## Naval Construction in 1923.

SHIPBUILDING for naval purposes continued to languish throughout the past year, particularly in Europe. Under the combined influence of Treaty restrictions and economic difficulties, the production of heavy fighting ships has been brought virtually to a standstill; but there are signs of increasing activity in the lighter branches of naval construction. The present situation is that Great Britain, the United States, Japan, and France, all have fairly large programmes in view, but in the case of this country and the United States parliamentary sanction for the schemes has yet to be secured. The outlook is, therefore, rather obscure at the moment, but there seems good reason to anticipate a marked revival in naval shipbuilding during the current year. Enthusiasm for the limitation of marine armaments is less in evidence now than it was two years ago, for it has come to be realised that the artificial restriction of fighting tonnage is by no means an unmixed blessing, to this country at any rate. It has undoubtedly aggravated the unemployment evil, as was inevitable, considering that at least one-fifth of the total tonnage launched at British shipyards in the pre-war period was represented by ships of war for the British or foreign navies. Practically, the whole of this work has now vanished, and the loss is felt the more acutely because it has coincided with an unparalleled slump in mercantile construction. From 1904 to 1914 the amount expended yearly on ships for the Royal Navy averaged £10,878,000, while the Board of Trade returns show that within this period of ten years warships to the value of £14,222,694 were built by British firms on foreign account, a yearly average of £1,420,000. Allowing for the substantial increase in prices, this yearly average of more than £12,000,000 would, nowadays, be nearer £18,000,000, of which sum about £13,000,000 would be paid out in wages. If exact figures could be obtained, showing the amount which has been disbursed in doles and other forms of relief to unemployed workers in the shipbuilding and kindred trades during the last two years, it would not improbably be found to exceed the cost of a large naval programme. In the end we may benefit financially, as well as politically, from the suspension of competitive naval building. So far, however, the economic results have not been of an encouraging nature.

### Great Britain.

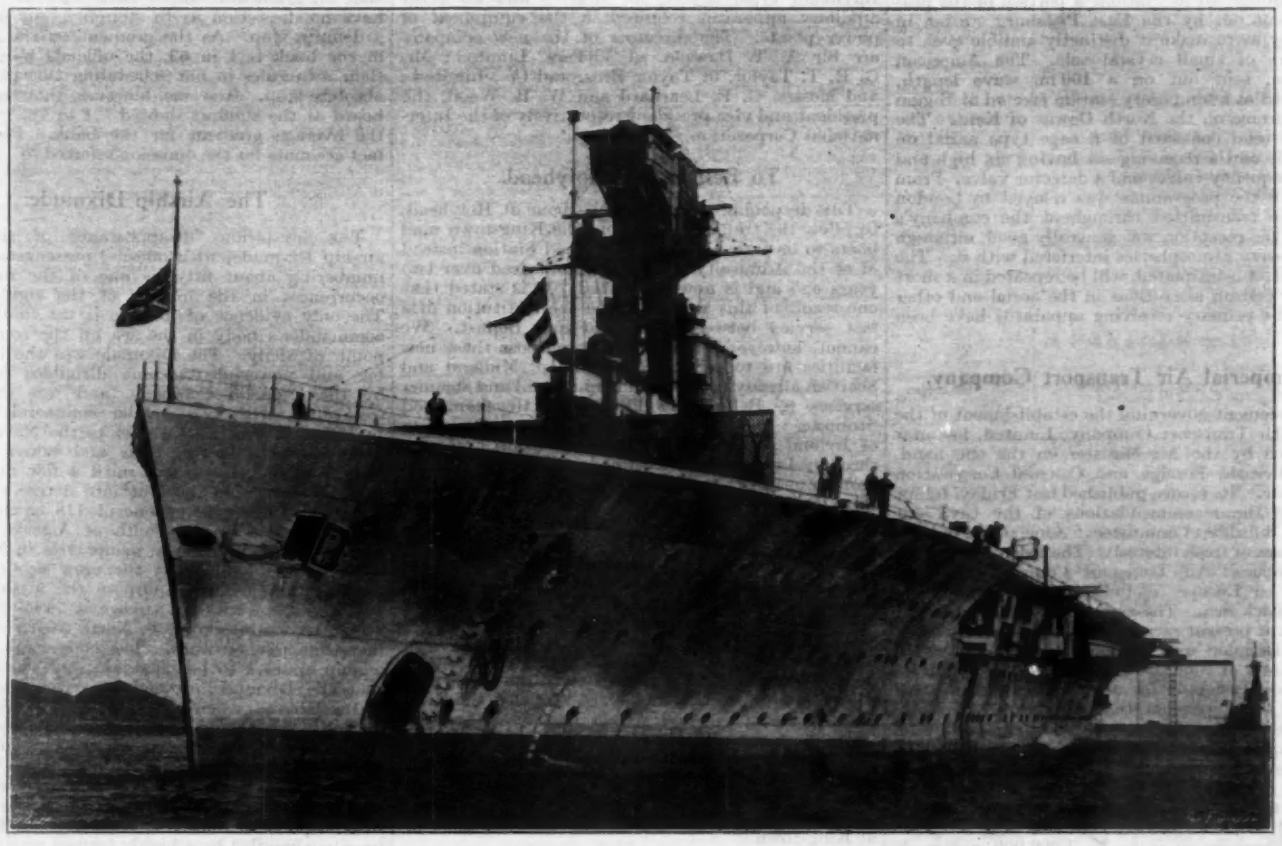
Work has now been proceeding for twelve months on the two battleships, Nelson and Rodney, which were laid down at the end of 1922. In the normal course of events they would, therefore, be approaching the launching stage, but both are, in fact, in a backward state, work having been retarded by the boilermakers' dispute. It was announced in Parliament on May 2nd of last year that only 109 workmen were employed at that time on the Nelson. This vessel is being built by Armstrong, Whitworth and Co., on the Tyne, and her propelling machinery by the Wallsend Slipway and Engineering Company. The Rodney is under construction at the Birkenhead yard of Cammell Laird and Co., who are also supplying the machinery. For reasons known only to itself, the Admiralty still withholds information concerning the design of these vessels, although there is no apparent reason for secrecy in the matter, seeing that other Powers are debarred from building new capital ships for a space of ten years. While, therefore, the salient characteristics of the two vessels are known to a great many people, we shall confine ourselves to quoting the following unofficial details from the latest edition of "Brassey": Length, 680ft.; beam, 106ft.; displacement, as fixed by Treaty, 35,000 tons. "They will carry nine 16in. weapons in three triple turrets . . . and the anti-torpedo bulge will be fitted, as it were, inside instead of outside the hulls." These vessels are of peculiar interest for more than one reason. They are, for example, the last capital ships that the British Empire is entitled to build until 1931; the last ships of this type to be designed by Sir E. T. d'Eyncourt, the retiring Director of Naval Construction; and the first ships of the Royal Navy which have been designed within a limit of displacement prescribed by international agreement. Owing to this limit in size, it has obviously been impossible to incorporate in the design all the qualities indicated as desirable by the experience gained at Jutland and in other actions of the Great War. As proof of this statement, we need only cite the fact that the four "super-Hoods," ordered in 1921—but afterwards cancelled—were to have displaced over 47,000 tons each.

Four light cruisers of the war programme are still incomplete, viz., Frobisher, Effingham, Enterprise and Emerald. It is hoped, however, to deliver the Frobisher early this year, in readiness for commissioning as cruiser flagship in the Mediterranean. When seen at Devonport at the end of October, this vessel was well advanced. Her consort, the Effingham, is completing at Portsmouth, but in her case progress has been very slow. Both ships were designed as far back as 1915 as a new type of ocean-going cruiser for commerce protection, with a displacement of 9750 tons. The Enterprise, completing at Devonport, and the Emerald, at Chatham, are ships of 7600 tons, designed to attain, when in light condition, a speed of 33 knots. At the present rate of progress it is doubtful if either will be ready for service this year.

On October 25th the Prime Minister announced the impending adoption of a new programme of light naval construction. In his election address of November 17th he reverted to this subject in the following words: "The position of shipbuilding, one of the hardest hit of all our industries, is peculiar. It can only recover as shipping revives with the development of Empire and foreign trade. . . . We propose, in the meantime, to give it special assistance by accelerating the programme of light cruiser construction which will, in any case, become necessary in the near future. We are informed by our naval advisers that some seventeen light cruisers will be required during the next few years in replacement of the 'County' class, as well as a variety of small and auxiliary craft, and we intend that a substantial proportion of these shall be laid down as soon as the designs are ready and parliamentary sanction secured." The intention was, we understand, that from six to ten cruisers should be ordered early in the New Year, Barrow and the Clyde being among the districts to which contracts were likely to be allotted, while several of the ships were to be built in the Royal Dockyards. This programme, however, may be modified in consequence of the Government's defeat in the General Election. According to unofficial statements, the new cruisers were to have been of uniform design, with a displacement of 10,000 tons, and an armament of 7.5in. or 8in. guns. The estimated cost was £1,880,000 per ship. In the interests of the shipbuilding industry, it is to be hoped that the new Parliament will endorse the programme, in part, if not as a whole.

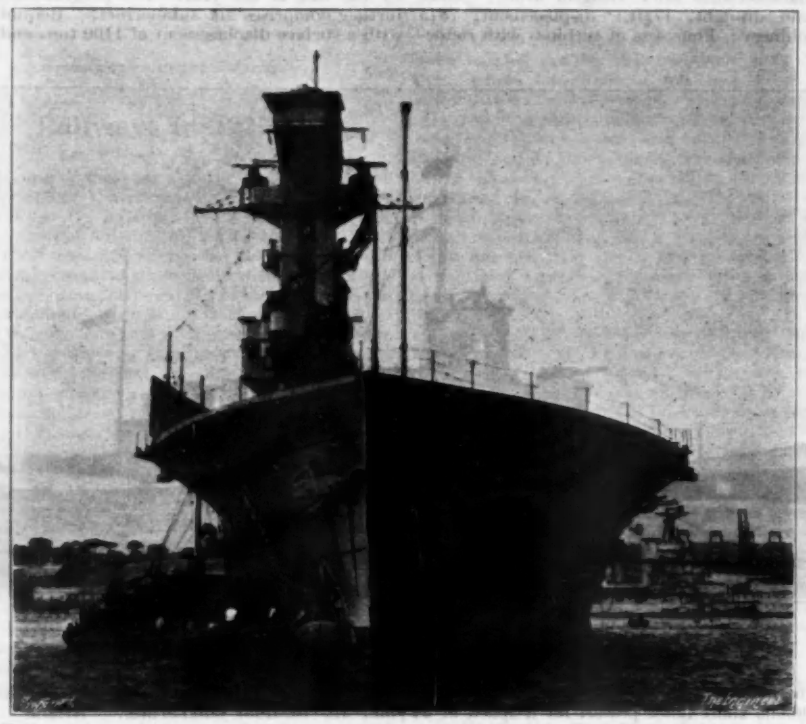
No particulars have been divulged of the cruiser-minelayer Adventure begun at Devonport in November, 1922. She is the first vessel of her type to be built for the British Navy, and her dimensions, judging from a photograph—taken as she lay on the slip and published some weeks ago—will be considerable. Early reports that credited her with Diesel machinery appear to lack substance. She is more likely to have geared turbines, corresponding in power to those installed in our cruisers of the "D" class. The only other vessel of war laid down in this country since the peace is the submarine X.1, begun at Chatham in November, 1921, and launched on June 16th last. With a displacement of 2780 tons in surface trim, and of 3600 tons when submerged, she is the largest submarine which has, so far, been constructed by any Power. Many sensational and inaccurate accounts of this vessel have appeared in the Press, but the authentic details must be reserved for the time being. From the engineering point of view she is of special interest, for her propelling machinery is believed to represent the latest British practice in the design of internal combustion engines. Her speed, however, will be less than that of vessels of the 24-knot "K" class, which are propelled by steam turbines. The last unit of this class, K.26—laid down by Vickers during the war and completed at Chatham Dockyard—was commissioned last May, and has just left Portsmouth on an independent cruise. She is larger than the earlier boats of the "K" class, her displacement being 2140 tons above and 2770 tons below water, as compared with 1880 and 2650 tons. It is unlikely that any further steam-driven submarines will be built for the British Navy. Two photographs of the K. 26 by Stephen Cribb, of Southsea, are reproduced on page 4.

H.M.S. Hermes, the first ship in the world to be



H.M. AEROPLANE CARRIER HERMES

planned and built as an aircraft-carrier, was completed at Devonport in July. We reproduce here three photographs of her made by Messrs. Abrahams and Sons, of Devonport. Her leading dimensions, &c., are:—Length overall, 594½ft.; breadth at waterline, 70ft.; across flight deck, 90ft.; mean draught, 18½ft.; normal displacement, 10,400 tons; machinery, Parsons turbines with gearing for 40,000 shaft horse-power = 25 knots.—As the narrow superstructure,



BOW VIEW OF THE HERMES

single large funnel, and tripod mast are placed at the extreme starboard side of the ship, her appearance, when viewed end-on, is most singular, not to say grotesque. The flight deck is well cambered and curves downward toward the stern, and is surrounded by a narrow safety net. The bulges in this ship are worked into the hull, and are, therefore, hardly visible. Although the great overhang of the flight deck gives the ship a top-heavy look, the trials already made last year show her to be a good seaboat. H.M.S. Eagle—formerly the Chilean battleship Almirante Cochrane—has just emerged from her second reconstruction, which was carried out at Portsmouth. Her displacement, it will be recalled, is 22,790 tons, and her speed 24 knots. The aircraft-carrier Furious, of 19,100 tons and 31 knots, is undergoing an extensive refit at Devonport, which will completely alter her appearance, but no details of her amended design are available.

**United States.**

With the completion of the sister battleships Colorado and West Virginia, in September and November respectively, the American quota of capital ships is filled, and no further units of this type can be laid down before 1931. The "Maryland" class to which these two ships belong has been fully described in THE ENGINEER. Their completion brings the number of capital ships fitted with the electric drive up to six. This system of propulsion has been sharply criticised by Mr. J. C. Shaw, assistant chief engineer to Wm. Cramp and Sons, the well-known shipbuilding firm of Philadelphia, in a recent communication to the American technical papers. The actual results of the system have, he asserts, fallen far short of the claims made by its sponsors. Comparing the performance of ships with electric drive and those with geared turbines, he finds the oil consumption per shaft horse-power to be "about 30 per cent. greater for the electric drive using superheated steam" than that of the modern compound marine turbine using saturated steam. On an average, he states, the electric drive requires 18 per cent. more oil per shaft horse-power at full power, 22 per cent. more at one-half power, and about 90 per cent. more at one-tenth full power, the latter corresponding roughly to the 10 knots' cruising speed of battleships. Mr. Shaw further denies the supposed advantages of electric drive in regard to greater reliability in service, improved flexibility of drive, and simplicity of control. In ships so equipped it is necessary, he declares, to have a specially trained engineering staff, owing to the liability of short circuits in the windings on account of moisture, and "the ever-present danger with the high voltage employed and the defects of the induction or synchronous motor when used for this service."

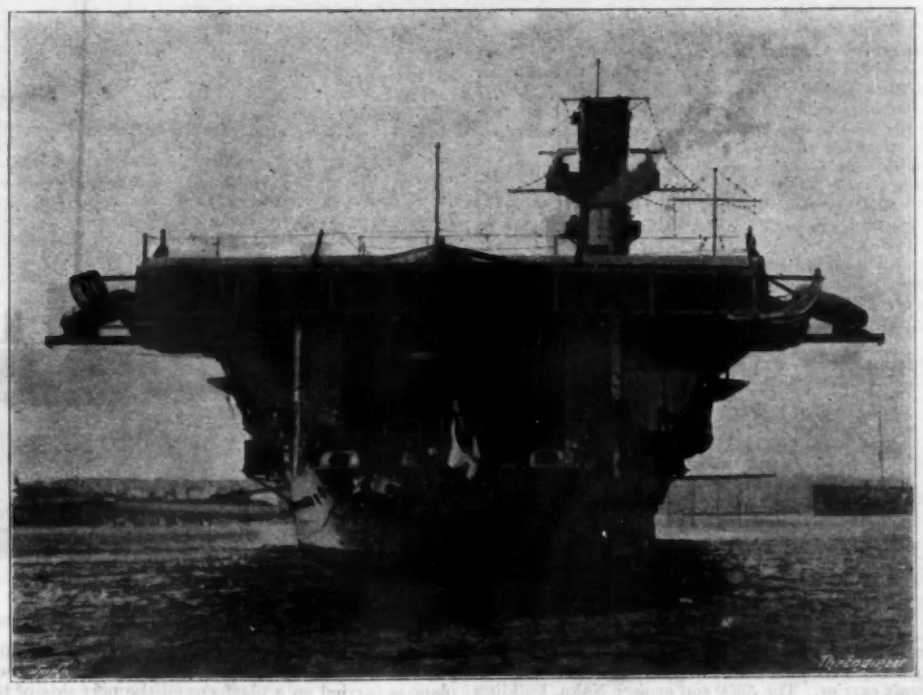
During the past year six ships of the "Omaha" scout cruiser class, laid down in 1918–20, have been passed into service, and all have done well on their trials. These vessels, which displace 7500 tons, are at present the swiftest cruisers of any navy, several of them having exceeded the designed speed of 33.7 knots. We illustrate on page 16 the Detroit, of this class, running her trials. For this photograph, as for that of the battleship Colorado, we are indebted to the courtesy of the U.S. Navy Department. They are driven by turbines with reduction gearing, supplied with steam by twelve Yarrow or White-Forster boilers, and turning four screws. There is only a thin patch of armour on the side amidships, but all guns of the main armament—twelve 6in. 53 cal.—are protected by splinter-proof plating, four being in double turrets and the remainder in casemates. The disposition permits of an axial fire of six and a broadside of eight guns. There was some apprehension that these ships, with their high-powered machinery and relatively heavy armament, were not sufficiently large or strong for cruising on the high seas; but more than one of them has already steamed many thousands of miles without showing any sign of strain in hull or machinery. In short, they appear to be a thoroughly efficient and successful design. Of this class the Trenton was launched on April 16th and the Marblehead on October 9th, while the Raleigh and Memphis, when last heard of, were still on the stocks, their construction having been delayed by the exhaustion of credits. The only other ships now under construction are the Lexington and Saratoga, laid down in 1920-21 as battle-cruisers, but since re-designed as aircraft-carriers; and three large submarines, of 2025 tons surface displacement. At the moment of writing, however, a new shipbuilding scheme is before Congress. It provides for eight cruisers of 10,000 tons each, to be armed with 8in. guns; six shallow-draught gunboats for service on the Chinese rivers; and three submarines of the "cruiser-submersible" type.

According to an official sketch and other details which have been divulged, the Lexington and Saratoga, when completed, will resemble the British aircraft-carriers Hermes and Eagle, superficially, at any rate. One enormous funnel and a slender cage foremast will be placed on the extreme starboard beam. The ships will have a length overall of 887ft., a beam of 105½ft., and a mean draught of 31ft. As battle-cruisers they were to have had turbines with electric drive, generating 180,000 horse-power for a speed of 33.25 knots. If this plant is retained the reduction in displacement by some 10,000 tons should result in a higher speed. Each ship is fitted with deep bulges which extend almost from end to end of the hull.

A serious misfortune befell the United States Navy on September 9th, when a division of "flush-deck" destroyers, all of the latest type, came to grief on the rocks in Santa Barbara channel, California. The disaster occurred when the vessels were steaming at 20 knots in foggy weather. The following boats became total losses:—Delphy, Chauncey, S. P. Lee, Fuller, Nicholas, Woodbury, Young.

**Japan.**

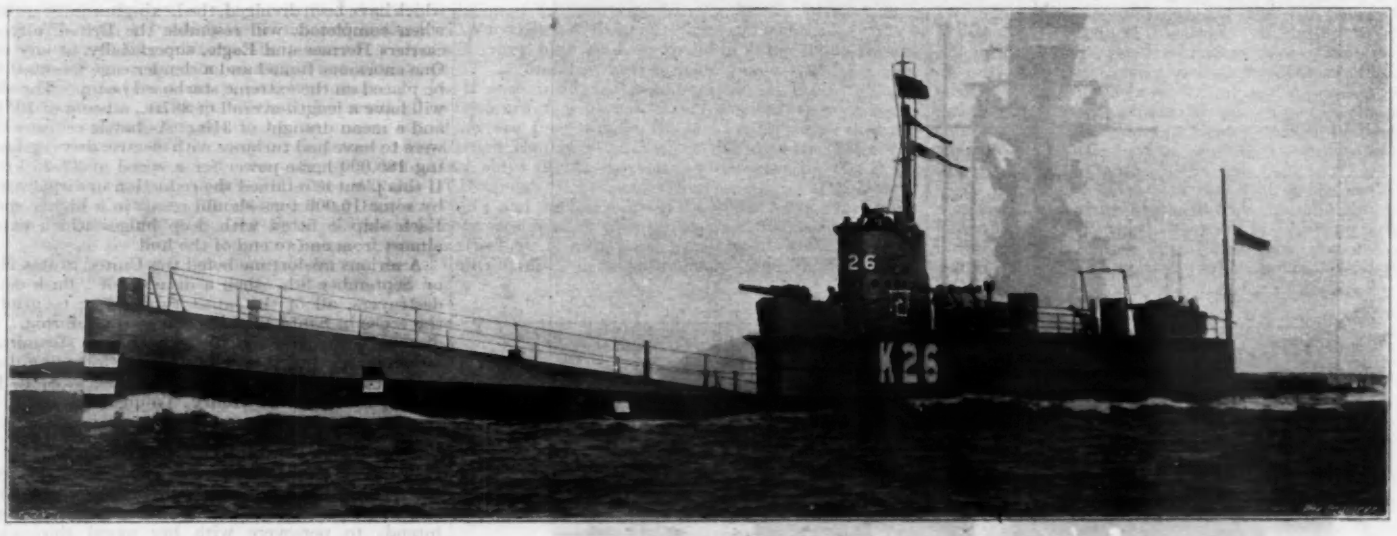
In spite of the heavy national losses suffered through the terrible earthquake of September 1st, it has been made clear by recent official statements that Japan intends to persevere with her naval shipbuilding programme. The period covered by it has been extended from 1927 to 1928, but otherwise it has not been modified in any way. According to a statement made by the Japanese Embassy in London last August, the following ships were then under construction:—Cruisers, two of 7100 tons (Kako and Furutaka), five of 5500 tons ("Tama" and "improved Tama" class), one of 3100 tons (Yubari); destroyers, seven of 1400 tons, four of 900 tons; submarines, thirteen; aircraft carriers, two; gunboats, four of 338 tons; special service vessels, five. Besides these, it is stated unofficially, the following ships have been authorised for early construction:—Cruisers, four of 10,000 tons, two of 7100 tons; destroyers, eighteen of 1500 tons; submarines, sixteen of 1500 to 2000 tons. The first cruiser of the new 10,000-ton class, named Myoko, is to be laid down at Kure dockyard early this year, and the keel of a sister ship, Nachi,



STERN VIEW OF THE HERMES

will be laid at Yokosuka as soon as the earthquake damage at that port has been repaired—probably by next June. The 7100-ton Kako and Furutaka, now being built respectively at the Kawasaki yard, Kobe, and the Mitsu Bishi plant, Nagasaki, are both due to be launched in June. These ships will be armed with 6in. guns, but the Myoko, Nachi, and others of the larger class will probably mount 8in. guns. The newest Japanese cruisers all appear to be de-

signed for a speed of 33 to 34 knots. The Sendai, of 5570 tons, was launched at the Mitsu Bishi yard, Nagasaki, on October 31st. Like other vessels of the "improved Tama" class, she will have machinery of 90,000 shaft horse-power and an armament of seven 5.5in. guns. Nothing definite is known about the new destroyers, except that all will be of a heavy ocean-going type. Submarines of 1500 tons are now building, together with a few smaller boats of rather less than 800 tons. A new boat of this latter type, No. 70, foundered in August while running her trials, and ninety lives were lost, including many officials of the Kawasaki Dockyard




H.M. SUBMARINE K. 26

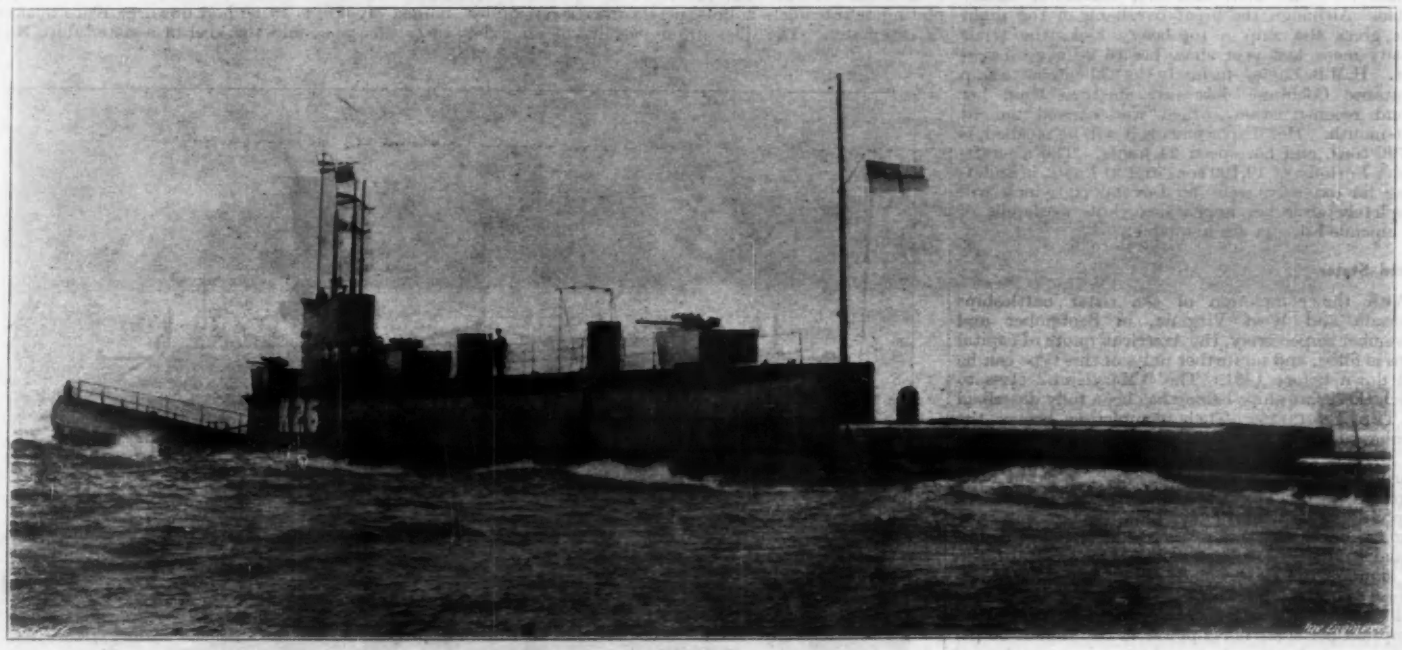
Kobe, where she was built. The boat has since been salved and is now under repair. During the earthquake and the resulting fire, so much damage was done to the aircraft carrier Amagi, building at Yokosuka, that she has had to be scrapped. She was begun originally as a battle cruiser, but was afterwards re-designed for the purpose named. She will be replaced as an aircraft carrier by the former battleship Kaga, which will have, when completed, a displacement of 26,900 tons and a speed of 23 to 24 knots, being thus closely akin to H.M.S. Eagle.

The Akagi, a sister battle-cruiser of the Amagi, is also being reconstructed at Kure Dockyard as an aircraft carrier. The 5500-ton cruiser Naka, building at Yokohama, was severely injured in the earthquake, but the authorities hope to repair her. Should it prove impossible to do so, a new cruiser will be laid down in her place. It is of interest to note that, with the scrapping of ships condemned under the Treaty, the entire Japanese fleet, with the single exception of the battle-cruiser Kongo, now consists of vessels built in that country.

**France.**

At Brest, on August 14th, was launched the cruiser Duguay-Trouin, the first warship of considerable size to be set afloat in France for many years. As she had been on the stocks less than thirteen months, a rapidity of construction that affords signal proof of the efficient state, which the French dockyards have now reached, is indicated. The keel of a sister ship, Primaguet, has since been laid on the vacant berth at Brest, while La Motte-Picquet, a third unit of the class, will shortly be floated out of the dock at Lorient. Diagrams and full particulars of these ships have appeared in the French Press. Their leading characteristics are: Length, 575ft.; beam, 57ft.; mean draught, 17½ft.; displacement, 7875 tons. Machinery: Four sets of turbines with reduction gearing, turning four shafts and developing a total of 96,000 shaft horse-power, for a speed of 34 knots; eight small-tube boilers fired with oil fuel. Radius of action at 15 knots, 4000 miles. Light armour is fitted to the sides in way of machinery spaces, steel decks are worked over vital parts, and buoyancy is protected by elaborate subdivision. Armament: Eight guns of 6.2in., mounted in four turrets, two at each end of the ship; four 3in. anti-aircraft guns, and twelve 21.6in. torpedo tubes above water. The 6.2in. turrets are fitted for high-angle firing, a sliding embrasure covering the gun-port at normal elevations. A small scouting aeroplane is carried on a platform on the port side of the ship, abaft the mainmast. The foremast is a tripod, fitted with a director tower and tops. There are two short funnels. These particulars are taken from the journal *L'Illustration*, which adds: "The cruisers have very beautiful lines, their silhouettes are elegant, they poise well on the water, and their sharp clipper bows, with a wide flare, are well adapted for running at high speed. The shape of the stern resembles that of a racing motor boat. As a whole, they give a harmonious impression of solidity and equilibrium."

The Jaguar, one of the six large destroyers begun in 1922, was launched at Lorient in October last. Her displacement is 2400 tons, and she is equipped with two sets of Rateau turbines and five small high-pressure boilers, to develop 48,000 shaft horse-power and 35.5 knots. A very powerful armament is carried, viz., six 5.1in. guns, two 3in. A.A. guns, and six 21.6in. torpedo tubes. Twelve smaller destroyers of the "Bourrasque" class—1400 tons, 33.5 knots, four 5.1in. guns, four tubes—are also under construction, but none had been launched by the end of the year. The programme in hand further comprises six submarines, "Requin" class, with a surface displacement of 1100 tons and a speed of 16 knots, all building in Government dockyards; and six medium submarines, "Ariane" class, of 680 tons and 14 knots, which are being built by contract. Work has been in progress for nearly a year on the former battleship Béarn which is being converted into an aircraft carrier at La Seyne. Reference was made in our issue of December 14th to the second half of the French programme, which provides for six cruisers of 10,000 tons, fifteen destroyers of 2400 tons, and twenty-four of 1450 tons, four submersible cruisers of 3000 tons, thirty submarines of 1300 tons, and several auxiliaries. None of these ships had been ordered by the middle of December.




H.M. SUBMARINE K. 26

**Other Navies.**

The Italian Government has adopted a new four-year building programme, embracing five light cruisers, twenty destroyers, and twenty submarines. Two cruisers, four destroyers and four submarines are to be laid down this year. Spain is completing, at her Ferrol yard, two cruisers of 4725 tons and 29 knots, named Don Blas Lezo and Mendez Nunez. She proposes to lay down at an early date two larger cruisers, of 7975 tons and 33 knots, from designs prepared by Sir Philip Watts, now of Elswick. In addition, a number of destroyers and submarines

are being built at Ferrol and Cartagena. In Germany a new light cruiser, Dresden, of 5600 tons, is on the stocks at Wilhelmshaven, but progress is retarded by monetary troubles. There have lately been reports of naval shipbuilding activity in Russia, but the dockyards and technical establishments of that country have deteriorated since the revolution to an extent that renders any major construction impossible for the time being. The Netherlands naval programme has been abandoned, owing to the recent defeat of the Government on this issue. No other small maritime State has any new shipbuilding in hand, or, apparently, in view, a circumstance doubtless explained by the present high cost of man-of-war construction.

## Railways in 1923.

THE opening of the year saw the completion, with one exception, of the amalgamation of the twenty principal railway companies into four groups. The exception was the Caledonian, which company, as it declined the terms offered by the London, Midland and Scottish, remained to be dealt with by the Railway Amalgamation Tribunal, by which an arrangement was concluded on June 25th. Eighty-six of the ninety-three subsidiary companies, which were to be absorbed by the four grouped companies in accordance with the first schedule of the Railways Act, accepted at once the terms of their respective groups, and the cases of the remaining seven were settled by the Amalgamation Tribunal. Outside the grouping scheme there remain the Metropolitan, Metropolitan District, London Electric, Liverpool Overhead, and Mersey Railways, together with all lines jointly owned by two or more groups and the light railways.

After seven years' almost complete stagnation the railway companies having under grouping consolidated their position, once more set up new works programmes. Few, if any, of these programmes were a direct result of grouping. For the most part the works were planned prior to, and deferred because of, the war. We summarise them under the titles of the groups.

### Southern Railway.

The principal work of the engineering department of the Southern Railway during the past year was mainly administrative. Owing to the amalgamation of the three southern railways, the works department had to be reorganised, with the effect that the former nine districts of the three separate chief engineers have been reduced to seven.

On the former London and South-Western good progress was made with the laying-down of the new sidings at Exmouth Junction, necessary in anticipation of the creation of a new large locomotive depôt there in substitution of the present shed and yard. At Exmouth the passenger station is to be reconstructed, and the first step in this scheme is the building of a new goods shed and sidings, which work is well in hand.

The contract has been let for the Totton, Hythe and Fawley Light Railway, sanctioned, under the Light Railways Act, in January, 1922. The railway is 9 miles in length, all single line. The Basingstoke and Alton Light Railway—opened in 1901 and never a paying proposition—was closed during the war and then dismantled for the materials to be sent overseas. Powers were sought in the late session to abandon it, but eventually the company agreed to restore it and give it a further test. Three-fourths of the restoration have been completed.

The gravitation yard at Feltham is, with the completion during the year of the engine shed and a 120,000 gallon water-tank—both in ferro-concrete—now finished. In connection with this scheme there are 128 houses for the workmen, of which about 100 are occupied.

In anticipation of the renewal of Rockley Viaduct on the Weymouth line cast iron cylinders, 7ft. and 9ft. diameter, are being sunk to a depth of 70ft. below high water. This work is nearly completed, and, when finished, will allow the present superstructure of seven spans of 20ft. each to be replaced by one span of 130ft., the ends of which will rest on the cylinders above named.

At Redbridge the engineers' permanent way depôt is being reconstructed and enlarged. It will now include a creosoting plant and sleeper yard. The creosoting cylinders will each be of a capacity to take 350 sleepers, and the yard will be able to turn out about 250,000 sleepers a year.

*South-Eastern Section.*—On this section the double line opening bridge over the river Stour between Minster and Sandwich was replaced by a fixed bridge of three spans—a central span of 55ft. and two side spans of 26ft. 6in. each. The abutments are of mass concrete on pile foundations, and in the river are two rows of three cylinders sunk to a depth of 45ft. The foundations for these cylinders present an interesting feature. After the cylinders had been sunk the necessary depth the clay was undercut under air, and a concrete foundation of larger dimensions than the diameter of the cylinders and having tapered sides was made. The superstructure consists of three lines of main girders with a pressed trough flooring. One half of the old bridge was dismantled and one half of the new bridge erected at a time.

The opening bridge over the river Swale on the Sheerness branch, which gives rail and road communication with the Isle of Sheppey, was restored and re-opened on December 1st, and the bridge carrying the railway over High-street, Clapham, was nearly completed. Conductor rails have been laid on 50 miles out of the 210 miles of line to be converted to electric traction.

### Great Western.

One of the most important of the new works now being carried out by this company is at Newport, Mon., where four lines of way are being provided at the east end of the station. This work necessitated the widening and reconstruction of the bridges over Shaftesbury-street and the Eastern Valleys Railway and of the viaduct over the river Usk. It is hoped to open the four lines throughout next summer. It is intended shortly to reconstruct Newport passenger station at a cost of about £500,000, and in anticipation of this work the carriage sidings are being dispensed with and substituted by new sidings and a carriage shed near the Maesglas locomotive depôt west of the tunnel on the west side of the station.

Work on the Wolverhampton and Bridgnorth Railway and the extension of the Kingswinford branch to join that railway, which was suspended during the war, has been resumed. The permanent way is being laid and it is hoped to open the lines in the summer.

The deviation of the line so as to dispense with Brunel's wooden viaducts at Penrhyn and Pascoe, and the construction of a new station at the former place, were completed last autumn. A contract was let some months ago to replace Penwithers Viaduct by a solid embankment. The work will require 250,000 cubic yards of filling.

At Fowey a new jetty, 500ft. long and 50ft. wide at the bend of the river where there is a good depth of water, was brought into use last September for the china clay traffic. The electrically operated belt conveyor is capable of dealing with 240 tons per hour and conveys at the rate of 125ft. per minute, including a lift of 35ft.

To meet the growing traffic on the Cambrian section, the 4½ miles between Welshpool and Forden are being converted from single to double line. It is hoped that the work will be finished in time for next summer's traffic.

Part of the dock work in hand and contemplated is provision at the tips for handling the 20-ton privately owned mineral wagons which the company has succeeded in getting many firms to adopt.

The new Kennington Viaduct over the river Thames near Littlemore, on the Princes Risborough branch, was opened in July. The former bridge was one of five spans, but the new one has only three spans, all 83ft. in length and weighing 23 tons each.

At Port Talbot a reinforced concrete jetty, 875ft. long, by the wharf side, was completed, and considerable reconstruction work is in hand at other docks of the Great Western. At Newport and Cardiff, for instance, sidings are being provided to hold 3000 more wagons.

### London, Midland and Scottish.

Included in the group covered by this title are such important systems as the former London and North-Western, Midland, Lancashire and Yorkshire and the Caledonian. Opportunity to obtain satisfactory information as to the progress of the new works thereon has not been available. We would, however, say that the work of deepening the inner harbour at Holyhead, to which reference was made in our last two annual articles, has now been completed.

In the forecast we gave a year ago as to the new works likely to be put in hand this year, two were mentioned which have been begun. One is the duplication of the two lines of way between Horbury Station and Wakefield, on the former Lancashire and Yorkshire Railway. The work includes the opening out of a tunnel, the reconstruction of the station at Horbury Junction—where the Barnsley branch joins—the construction of twelve new bridges, and the removal of 160,000 cubic yards of material, mostly rock. The other new work in hand is the building of a modern station at Bangor.

### London and North-Eastern Railway.

This vast system includes the former North-Eastern, Great Northern, Great Eastern, Great Central and North British Railways.

*North-Eastern Area.*—In no part of the country was more railway work done during the year than in that now known as the North-Eastern Area of the London and North-Eastern Railway. During the war the output capacity of all the industries in that area was increased by about 200 per cent., and when work is again in full swing the greater inwards and outwards traffic that will necessarily result will have to be provided for.

In the way of additional accommodation, up and down independent lines are being provided between Belford and Crag Mill. The sidings on the down side of the line immediately to the south of Darlington are being extended and made accessible from either end. Two up independent lines are being laid between Darlington South box and Croft Junction. This work, which was suspended for some time, is now nearly completed. At Heaton, near Newcastle, a re-arrangement and extension of the siding accommodation in the up goods yard is being carried out. On the up side of the line at Dringhouses, immediately south of York, a marshalling yard for trains to the Great Northern, Great Eastern and Great Central sections, was nearly completed. It has standing accommodation for over 600 wagons. The scheme for a big yard at Priory, outside Hull, which was developed before the war, reached its final stage during the year. It provides accommodation for 8399 loaded and 2385 empty wagons, and has 75 miles of sidings. At Sunderland and North Blyth arrangements to give increased coal shipping facilities were completed.

The new wagon building shops on the Faverdale Estate at Darlington are now nearly completed. The intention is that all wagon building shall be carried out there and that the wagon shops at York and Shildon shall be devoted entirely to repairs. The reconstruction of the electric car shed at South Gosforth, to replace those at Heaton destroyed by fire three years ago, was completed. The car shed itself is 720ft. long by 190ft. wide, built in three bays, and has ten tracks and accommodation for 120 cars. The adjoining repairs shed is 425ft. long by 60ft. 8in. wide, and has two tracks and a 30-ton overhead travelling crane.

At Mickley, on the Newcastle and Carlisle line, where the railway adjoins and runs parallel with the river Tyne, a retaining wall, 900 yards in length, is nearly finished. The repairs to the swing bridge at Goole, which was seriously damaged by fire on March 21st, 1922, are now nearly completed.

The principal dock work carried out during the past year was the construction of a new coaling staith at Hartlepool—with a new timber quay at that port—the extension of the Fish Quay sheds at the St. Andrew's Dock, Hull, and the provision of a new coaling appliance at that dock, together with two pairs of new gates for the Victoria Dock, Hull.

*Great Northern and Great Central Areas.*—The removal of Battle Bridge-road, mentioned in former annual articles, allowed an enlargement of King's Cross Station yard in the north-westerly direction to be effected. This work included the taking down of the retaining wall, 190 yards long, which was built in 1892, when the additional Gasworks Tunnel was constructed. On the space of 1½ acres thus set at liberty a 70ft. diameter engine turntable, a coaling stage, water column, and five sidings for locomotive purposes are being provided. The turntable is in position and the locomotive yard is approaching completion. Later, an additional local platform will be provided on the site of the existing locomotive yard and between the present Nos. 13 and 14 roads.

The widening between the Ouse signal-box and Huntingdon, about 1 mile in length, is well in hand. The work lies mainly on the down side of the line and is designed to provide additional up and down lines over the river Ouse. The new bridge over the river is 243ft. in length.

The Fletton Junction to Peterborough widening, about 1 mile in length, serves the same purpose in respect of the river Nene, and is also mainly on the down side. The principal work is in the form of a viaduct, 780ft. in length, consisting of an approach viaduct of nine arches in brick, followed by a girder bridge over the Great Eastern section, and then another over the river Nene. This work is well in hand.

The extension, 3 miles in length, of the Stainsby branch—south of Grantham—to some iron ore mines, made good progress during the year, and Harworth Colliery branch, nearly 3 miles in length, was completed.

On the Great Central section, the sinking of forty-four steel and cast iron cylinders at New Holland Pier is about half completed. This work is being carried out in connection with the strengthening of the approach to the pierhead, and a contract is about to be let for the reconstruction of the superstructure of the approach.

For the British Empire Exhibition at Wembley the up and down platforms at Wembley Hill Station were lengthened and widened and a reinforced concrete footbridge, 12ft. wide and spanning four lines of way, was built. Outside the exhibition grounds a new station was erected, which is served by a circular loop 1 mile in length.

*Great Eastern Area.*—Two carriage reception roads at Stratford are to be shortly brought into use. This has meant the widening of the line for some 20 chains in length between Bow and Stratford and has entailed the construction of four heavy steel bridges, designed in accordance with the rules recently proposed as standards for loads and impact effects.

*North British Area.*—The reconstruction of Dunninauld Viaduct and of the bridge over Wigton-road at Carlisle, the new terminal basin for the Union Canal, and of that part of the goods warehouse at High-street Station, Glasgow, which was destroyed by fire, mentioned in previous annual articles, was completed.

A part of the fairway wall of No. 3 Dock, Methil, was reconstructed during the year.

**Metropolitan District and London Electric Railways.**

On the former railway the principal work of note has been the reconstruction of the station at Westminster. The works at the street level were completed in November and include the provision of a booking hall with an area of 1300 square feet. The works on the station platforms are approaching completion.

Of the several important undertakings of the London Electric Railways, one was finished on November 19th. This was the extension of the Charing Cross, Euston and Hampstead Railway from Golders Green to Hendon, a distance of 1.63 miles. The station at Golders Green has been enlarged and now has one single-sided and two island platforms, each 370ft. long, with three platform roads; there is only one road between the two island platforms. Besides the new station at Hendon there is an intermediate one at Brent. At the Hendon end of Golders Green Station the railway crosses the Finchley-road by a girder bridge of 88ft. span. Golders Green-road is spanned by a similar bridge of 92ft. span, and Elmcroft-crescent by one of 129½ft. The Brent is crossed by two brick arches, with an approach viaduct of seven smaller arches, the total length being 300ft. and the maximum height 34ft.

The Hendon extension is being continued to Edgware, 3.05 miles, with an intermediate station at Colindale, 1.31 miles, and another at Burnt Oak, 2.21 miles from Hendon. This line passes under the main line of the Midland section of the London, Midland and Scottish Railway at Colindale by twin tunnels, nearly three-quarters of a mile long. The two headings of one of these tunnels met on November 20th and they were found to be only five-sixteenths of an inch out of alignment. It is expected that this further extension will be opened in the spring.

The work of joining the northern end of the City and South London at Euston to the Charing Cross, Euston and Hampstead at a point south of Camden Town Station, thus providing access to both Highgate and Golders Green, has made such progress that it is hoped to finish it by the spring. The City and South London lines pass under those from Charing Cross and Euston and approach them from the west at a point between Mornington-crescent and Camden Town stations, north of which there are, therefore, four running lines and south of which there are another four. All these are interconnected by means of six tubes, all cut in London blue clay. There is, however, no intersection on the level, all crossing being done by flying junctions in tubes.

The enlargement of the City and South London tubes to the standard dimensions found on the other such railways, so as to allow for through running, is making such progress between Euston and Moorgate that it is hoped to have this ready by the spring, which would permit of a through service between Edgware and Moorgate. The remaining portion of this enlargement, *i.e.*, between Moorgate and Clapham Common, has been hindered by the subsidence at Newington-causeway on November 27th. Here, some of the temporary timbering, used between where the original and the enlarged sections joined, gave way and the northbound tunnel was filled with earth. The mishap has had the result that the trains have been stopped entirely and full possession of the railway given to the contractor. It is now expected that this portion will be finished by the end of the year.

**Signalling.**

The outstanding event in railway signalling was the installation of automatic signalling between Marylebone and Wembley, on the Great Central section of the London and North-Eastern Railway. It was provided for the traffic to and from the British Empire Exhibition and was brought into use in time for the Football Association Cup Tie on April 28th. The signals are so spaced as to provide for a three-minutes' service. Two signal-boxes were dispensed with. A main feature of the work is the provision of day colour light signals giving three aspects—the first use of such signals on a main running line in this country.

At the adjoining station on the Metropolitan Railway some additional platform lines were laid in, the points of which vary in distance from the signal-box from 350 to 470 yards. These points are electrically operated by alternating current—the first instance in this country of the employment of alternating-current point mechanism.

We noted a year ago that the under-the-river section of the Mersey Railway had been automatically signalled between Liverpool Central, Low Level, and Hamilton-square Stations. At the former station there were two signal-boxes, whose almost sole purpose was to actuate the points for arriving and departing trains. It occurred to Mr. Joshua Shaw, the general manager and engineer, that this point operation might be done automatically by the trains themselves. He approached the Westinghouse Brake and Saxby Signal Company, which had installed the automatic signalling, and together they devised a scheme whereby a train, after coming to rest in the station, opens a cross-over road in front of it and clears a signal. On arriving in the siding the signal is put to "danger" and the points to normal. Some safety points are then closed and the signal cleared for the train to go to the departure platform. On arrival there the points and signal behind the train are restored.

At Waverley Station, Edinburgh, which is protected by four signal-boxes, with a view to improving the signalling and reducing the number of red lights on the bridges of signals at the ends of the station, mechanically worked route indicators have replaced all but one signal for each road, and a reduction of 40 per cent. has been made in the number of red lights.

Quite the most interesting piece of signalling now being installed in this country is in the Hampstead and Highgate tubes of the Charing Cross, Euston and Hampstead Railway, where a junction is being made with the extension from Euston of the City and South London Railway. At this point the Golders Green and Hendon line separates from the Highgate line at Camden Town. The City and South London Railway comes to Euston from almost due east and there passes under the Hampstead and Highgate line at right angles. It then curves towards the north-west until it runs parallel with and then joins the latter line south of Camden Town Station. The signal-box is situated at the south end of the northbound line platform on the Highgate branch, whence are worked the existing junctions. When the City and South London junction is opened there will be four sets of facing points and six sets of trailing points actuated therefrom, all of which will be out of the signalman's sight, and twenty-nine signals, of which only three or four will be visible from the box. Reliance on track circuit will, therefore, be absolute.

The Bedford-Sandy line of what was the London and North-Western Railway is a single line, controlled by the electrical train staff. During the year a new form of switching-out arrangement was put into force.

**Railway Accidents.**

There was during the year only one accident to trains in which passengers lost their lives. It occurred at Diggle, on July 5th, and was due to the driver of a goods train, which had been pulled up by a red flag, moving forward without permission and fouling the path of an express. The only other accidents of note were those at Retford on February 13th and Betley-road on May 28th. In the former the signals at two boxes were overrun by one of the East Coast up-night Scotch expresses, which, when it reached the third box, was still travelling at such a speed that it ploughed its way for 80 yards through a goods train on the same line. The driver, fireman and a locomotive inspector on the footplate were killed. The mishap at Betley-road was the fracture of the right-hand connecting-rod of an engine of the "Prince of Wales" class.

A remarkable feature of the accidents of last year, as to which reports have been published, is that only two—one in a fog at Queen's-road, near Waterloo, on January 17th, and the above mentioned one at Retford—would have been prevented by automatic train control. During 1922 there were eight such accidents.

**Railway Labour.**

During the year two important questions were under debate between the railway companies and the men's unions. One, which still remains unsettled, relates to the shopmen's war bonus. This is a rather confused matter. There are about 111,000 of these men, the majority of whom belong to the National Union of Railwaymen, but a minority—and herein lies the confusion—are members of one or other of twenty-eight craft unions. The railway shopmen enjoyed the 16s. 6d. bonus given to the men in all engineering shops, but when the railway companies wished to follow outside engineering firms and stop the bonus by three instalments the men took the case to the Industrial Court, which decided that they were in a different category to the men employed by outside firms. The railwaymen, however, accepted a 10s. reduction, and since the beginning of the year the companies have been endeavouring to obtain their consent to the removal of the balance. The policy of the leaders of the National Union of Railwaymen, and of Mr. J. H. Thomas in particular, has been to get the question referred to the National Wages Board, or, alternatively, to have a conciliation board for the railway shopmen. The other unions, fearful that the National Union of Railwaymen might thus win over their members, opposed this course. Meanwhile some of the more advanced members of the National Union of Railwaymen threatened to strike should there be any reduction. The Ministry of Labour has made several suggestions, but they have not been accepted by the crafts unions, and so the matter rests, probably because of the larger matter the companies have in hand, to which we shall now refer.

In the March following the Armistice a National Agreement was signed which gave the men certain concessions—over and above the eight-hours' day—as to overtime, Sunday duty, guaranteed week holiday, &c. The companies, on the ground that the railwaymen were now being better treated than were those in corresponding occupations, sought to modify these concessions, but not to interfere with the principle of the eight hours' day nor with the minimum rate of pay fixed in January, 1920. After several meetings between the representatives of the companies and the men the case eventually found its way to the Central Wages Board, and then, on November 8th, to the National Wages Board. The award of the latter was given on December 21st, and, in the main, favoured the men.

**General.**

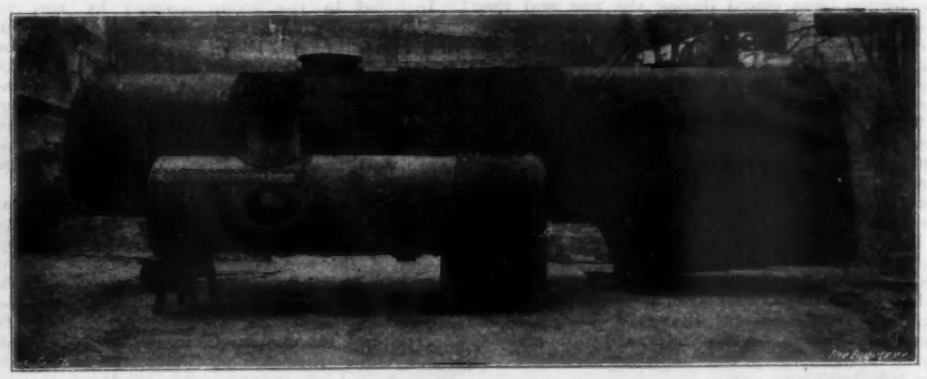
Mention should be made of the acceleration given as from July 9th in the 3.45 p.m. Great Western train from Swindon to Paddington, which now covers the 77 miles 24 chains in 76 minutes, or an average speed of 61.8 miles per hour. On the same day the London and North-Eastern installed a train of Pullman cars between London and Newcastle *viâ* Harrogate. This train covers the 186 miles between London and Leeds, with a momentary stop at Holbeck, in 205 minutes. The 11.50 King's Cross to Scarborough summer train ran non-stop to York—188 miles in 210 minutes. Another such train was the North Wales express of the London, Midland and Scottish, which was timed to run from Euston to Prestatyn, 205½ miles non-stop, in 239 minutes.

A reduction in freight rates was made on May 1st and another on various dates around August 1st. The Railway Rates Tribunal has now before it the proposed standard charges of the railway companies, which, under Sec. 30 of the Railways Act, must now be adjudicated upon by that body "after hearing all parties interested and who are desirous of being heard." The companies did not consider that season-tickets, traders' tickets and workmen's tickets came under the purview of the tribunal, but the Tribunal gave judgment contrary to this opinion. The subsequent publication of the companies' proposals for these tickets caused considerable unrest. A statement in the *Great Western Railway Magazine* that that company's directors would not countenance any increase in this respect had a satisfying effect.

## British Locomotives of 1923.

THERE is little or nothing to say about the locomotives of 1923. From the point of view of "trade" the year was about as bad as could be, very few locomotives of any kind were ordered, and as far as we have been able to discover by direct application to makers no new types were evolved. Progress on a few novel engines continued, but none of them are ready for the road.

We do not suggest that it has anything whatever to do with the matter, but it is, nevertheless, a subject for remark that the first complete year under "grouping" was, as far as new designs of companies' engines, well-nigh barren. It is possible that the four "chiefs" spent their time finding their way through their increased responsibilities; it is equally possible that the reduction of the number of individual engineers who might have designed new engines for their



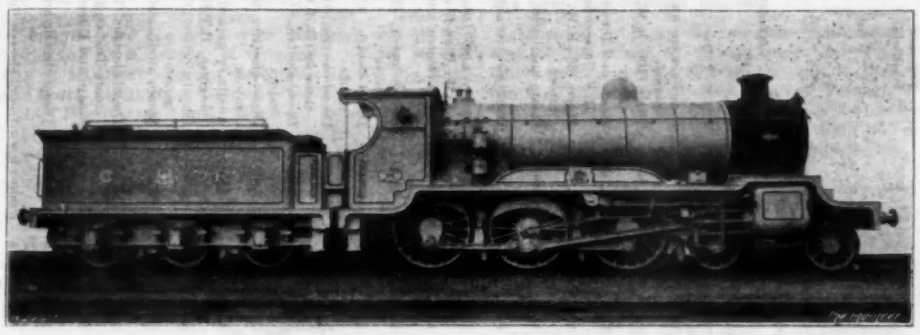
KITSONS' BOILERS FOR PACIFIC 5 FT. 6 IN. GAUGE ENGINE AND FOR 2 FT. 6 IN. GAUGE ENGINE.

own lines has for the moment checked progress. Whatever the cause may be, the fact remains, that we find only three engines worth illustrating, in one of our Supplements to-day, on account of novelty. Of these three we must give the place of honour to the Caerphilly Castle of the Great Western Railway, which develops a greater draw-bar pull than any British engine, although its grate area is less than that of the Great Northern and North-Eastern "Pacifics." The Caerphilly Castle—one of a class of ten all to be named after famous castles, has four cylinders, each 16in. by 26in., driving wheels 6ft. 8½in. diameter, a working pressure of 225 lb., thus developing a tractive effort at 85 per cent. steam pressure of 31,626 lb. Her grate area is 30.28 square feet. The North-Eastern engine has three cylinders, 19in. by 26in., driving wheels 6ft. 8in. diameter, and a working pressure of 200 lb. She develops a tractive effort of 29,918 lb. at 85 per cent. boiler pressure, and her grate area is 41.5ft. The Great Northern engine has three cylinders of 20in. by 26in., a boiler pressure of 180 lb., wheels 6ft. 8in., a grate area of 41.25 square feet, and a tractive effort at 85 per cent. boiler pressure of 29,835 lb. It is interesting to observe that if the Raven engine were raised to the Collett pressure it would have a tractive effort of nearly 34,000 lb., and that if the Gresley engine were treated in the same way its tractive effort would be over 37,000 lb. We might pursue many interesting comparisons between these three engines, which are certainly the most interesting normal British locomotives of recent years, but it is perhaps sufficient to notice that, as we have shown, it is the high pressure that gives the Great Western engine its advantage in draw-bar pull, and that, as a matter of fact, it has a much smaller boiler than either of the others, its evaporative surface being only 2050 square feet, against the 2930 of the Great Northern engine and the 2365 of the North-Eastern engine. The ratios of evaporative surface to grate area for the three engines are:—G.W.R., 1 : 67.5; G.N.R., 1 : 71.0; and N.E.R., 1 : 57.0. The relative cylinder volumes in cubic inches are:—G.W.R., 20,900; G.N.R., 24,500; N.E.R., 22,000; and the ratios between cylinder volume and evaporative surface are:—G.W.R., 1 : 10; G.N.R., 1 : 8.0; and N.E.R., 1 : 9.2. Lastly, the ratios between grate area and cylinder volume for the three engines are:—G.W.R., 1 : 690; G.N.R., 1 : 590; and N.E.R., 1 : 500. Differences of this kind are always interesting, and it is perhaps worth while tabulating them.

| | Great Western. | Great Northern. | North-Eastern. |
|---|---|---|---|
| Grate area .. .. | 30.28 .. | 41.25 .. | 41.5 |
| Evaporative surface | 2,050 .. | 2,930 .. | 2,365 |
| Cylinder volume | 20,900 .. | 24,500 .. | 22,000 |
| Ratios— | | | |
| ES ÷ GA .. | 1 : 67.5 .. | 1 : 71 .. | 1 : 57 |
| CV ÷ ES .. | 1 : 10 .. | 1 : 8 .. | 1 : 9.2 |
| CV ÷ GA .. | 690 .. | 590 .. | 530 |

Another notable engine of the year is Mr. Maunsell's three-cylinder six-coupled locomotive for the Southern Railway, which was fully described in THE ENGINEER of February 23rd last. Her cylinders are 16in. by 28in. and the valve gear is a modification of the Gresley design. The two outside cylinders are horizontal, but the inner one is inclined at 1 in 8 to clear the leading axle, and to correspond with this inclination the centre crank pin is set at 113 deg. to the right-hand pin and 127 deg. to the left pin. The total heating surface is 1526 square feet and the tractive effort at 80 per cent. of the working pressure—190 lb.—is 24,600 lb.

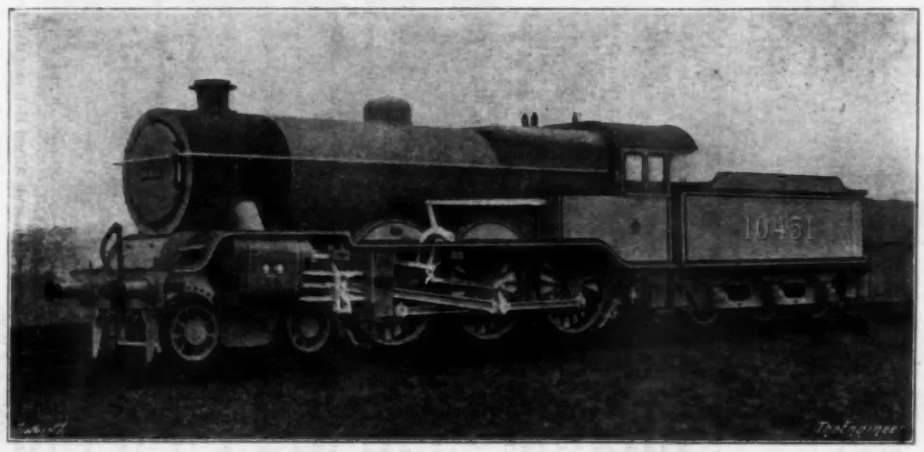
A series of large eight-coupled tank engines of Crewe design went into service on the London, Midland and Scottish Railway and were described in our issue of November 2nd. They weigh 88 tons and develop 30,500 lb. tractive effort at 85 per cent. of the working pressure. They were particularly designed for the heavy mineral traffic of South Wales.



L.M. AND S. RAILWAY SIX-COUPLED ENGINE BUILT BY THE NORTH BRITISH LOCOMOTIVE COMPANY

A trial is being made on the London, Midland and Scottish Railway of a modification of the Walschaerts gear, which enables it to be used with inside cylinders. The mechanism is due to Captain Beames. The essential feature is a dummy valve spindle placed outside the frame just where the real spindle would come. This spindle is reciprocated by the usual combination lever, but, since the crosshead which usually drives the lever is absent, motion is taken from the leading end of the coupling rod by a light connecting-rod. The dummy spindle operates a horizontal rocking lever which drives the valves.

We illustrate engine No. 10,451, which was built at Horwich last year, mainly on account of its tender and the number on its side. It may be noted also that the engine is painted in the new L.M.S. colours. The design is not new. It is a four-cylinder superheater engine of Horwich design, with 6ft. 3in. driving wheels developing a tractive effort of 29,470 lb. at 85 per cent. of the boiler pressure, which is 180 lb.




L.M. AND S. RAILWAY FOUR-CYLINDER SUPERHEATER ENGINE

The total weight of engine and tender in working order is a little over 119 tons. The cylinders are 16½in. by 26in.

From the Derby works of the L.M.S. were turned out several four-coupled 4–4–2 tank engines for use on the Tilbury section. They have 6ft. 6in. wheels, carry 1800 gallons of water in side tanks, 55 cwt. of coal in a bunker, and turn the scale at 71½ tons. They work with saturated steam.

### Makers' Engines.

As we have already observed, the year was a bad one for makers, and we have received very few replies to a large number of letters sent out, asking for information as to new types. We learn from the Yorkshire Engine Company that it had under construction during the year some large 4–8–4 engines for the Nitrate Railways. We hope to deal with them at an early date. Nasmyth, Wilson and Co., Limited, also carried out a fair amount of work, having built six 4–8–0 engines for Nigeria, ten 4–6–0 engines for India, six 2–8–2 double-bogie tender engines for the Gold Coast, and eight 4–6–4 tanker engines for the South Indian Railway. These are all narrow-gauge lines. Robert Stephenson and Co., Limited, completed towards the end of the year an order for ten "Mikado" type engines for the Sudan. They are of a new design and have bar frames and have feed-water heaters as well as superheaters. In Egypt, where coal is expensive and water scarce, economy of both is exceptionally important. A notable fact of the year was the purchase from Beyer, Peacock and Co., Limited, of many Garratt engines for the South African Railways, whilst Kitson and Co., Limited, started on some striking "Pacific" and "Mikado" designs for Indian railways. The difficulty that had to be faced was to get a big enough boiler within the space permitted. We give an interesting illustration of one of these huge boilers for a 4–6–2 engine of 5ft. 6in. gauge, in contrast with a 2ft. 6in. gauge boiler for a 4–8–4 engine. The grate area of the big boiler is 48 square feet, the total heating surface 2909 square feet, and the pressure 160 lb. The cylinders will have a diameter of 23in. and a stroke of 28in., driving 6ft. 2in. wheels. The "Mikado" (2–8–2) boiler is of the same size for 180 lb. pressure and the cylinders are the same, but the wheels are 4ft. 8½in. diameter instead of 6ft. 2in.

For the Northern Division of the L.M.S., some new 4–6–0 two-cylinder saturated engines were built by the North British Locomotive Company, Limited. One of them is illustrated on this page. They are being used on the Callander and Oban Line (Caledonian Railway). Their cylinders are 19½in. by 26in., driving 5ft. 6in. wheels. The total heating surface is 1823 square feet, and the grate area 21.9 square feet, the working pressure 185 lb., and the tractive effort, at 80 per cent., 23,500 lb. The total weight of the engine and tender, ready for the road, is a little over 100 tons.

## Motor Ships and Marine Oil Engines in 1923.

IT is with particular satisfaction that we place on record the good progress which has been made during the past year in the building of British motor ships and marine oil engines. Despite another year of almost unprecedented depression in merchant shipbuilding, fourteen motor ships were completed—see Table I.—with an aggregate of 78,862 gross tons and machinery representing about 49,137 indicated horse-power. A further seven ships, totalling about 29,602 gross tons and with machinery close upon 22,430 indicated horse-power, were built and are approaching completion, and the combined total again gives Great Britain the leading place in what is, without doubt, the most important step in present-day marine engineering. More significant, however, than the actual number of motor ships launched and completed is the fact that home developments embraced practically every type of marine oil engine of importance, and whatever that type may have been in the beginning, it has now received the definite impress of British marine practice representing experience gathered over long years of seafaring and marine engine building. To-day the brake horse-power developed per cylinder has increased from 200 to 300 up to 400 to 600, and in the case of the new double-acting Burmeister and Wain engine to over 1000 brake horse-power per cylinder. Such sizes of engine as are now possible leave no doubt that the day of the large motor liner has come, which fact is further shown by new vessels ordered by the Union Steamship Company of New Zealand, the Swedish-American Line, the Union Castle Line for a liner of 20,000 tons gross, as well as motor liners for the Royal Mail Steam Packet Company, Limited. The present position has not been reached without courage and initiative on the part of shipbuilders and engineers, and we firmly believe that this enterprise will receive the support it deserves, both from the shipowners at home and abroad. In the first table herewith reproduced we show the number of vessels of over 1000 tons gross and upwards, which have been built and completed in Great Britain and Ireland during the years 1920 to 1923. The figures illustrate the steady advance we have referred to. Actually many other ships would have been finished had not work on the hulls been retarded by the prolonged boilermakers' strike. Table II. serves to indicate some of the leading particulars of the motor ships begun and completed during 1923. An outline of the position is thus presented, but a few further details may perhaps be given concerning the progress made with each principal type of British-built marine oil engine.

### The Burmeister and Wain Engine.

Once again the Burmeister and Wain type of oil engine, built by Harland and Wolff, Limited, and its licencees, J. and G. Kincaid and Co., Limited, and W. H. Allen, Sons and Co., Limited, occupies the most important position as regards the number of ships launched and completed. During the past year Diesel engines were not only built at the

# MOTOR SHIPS AND MARINE OIL ENGINES OF 1923.

TABLE I.—*Vessels of* 1000 *Gross Tons and Upwards Fitted with Marine Oil Engines Built in Great Britain and Ireland and Completed During the Years* 1920–1923.

1920.

| Name. | Gross tons. | Engine builders. | Total I.H.P. |
|---|---|---|---|
| Dorsetshire | 7,445 | Harland and Wolff | 5,500 |
| Glenapp | 9,503 | Harland and Wolff | 6,400 |
| Glenluce | 6,755 | Harland and Wolff | 3,200 |
| Glenogle | 9,513 | Harland and Wolff | 6,400 |
| Glentara | 6,754 | Harland and Wolff | 3,200 |
| La Paz | 6,548 | Harland and Wolff | 3,200 |
| Narragansett | 6,889 | Vickers | 3,240 |
| Total | 53,407 | | 31,140 |

1921.

| Name. | Gross tons. | Engine builders. | Total I.H.P. |
|---|---|---|---|
| Conde de Churruca | 4,454 | Armstrong, Whitworth | 3,240 |
| Domala | 8,441 | North British Diesel | 4,660 |
| Köbenhaven | 3,901 | Burmeister and Wain | 840 |
| Leighton | 7,412 | Harland and Wolff | 3,200 |
| Lobos | 6,479 | Harland and Wolff | 3,200 |
| Losada | 6,520 | Harland and Wolff | 3,200 |
| Louisiana | 6,513 | Burmeister and Wain | 3,200 |
| Malia | 3,872 | Cammell Laird | 1,300 |
| Scottish Maiden | 6,993 | Vickers | 3,240 |
| Scottish Standard | 6,999 | Vickers | 3,240 |
| Segovia | 1,387 | North-Eastern Marine | 1,400 |
| Seminole | 6,923 | Vickers | 3,240 |
| Sevilla | 1,383 | North-Eastern Marine | 1,400 |
| Somersetshire | 7,456 | Harland and Wolff | 4,500 |
| Yngaren | 5,247 | Doxford | 3,000 |
| Total | 83,980 | | 42,860 |

1922.

| Name. | Gross tons. | Engine builders. | Total I.H.P. |
|---|---|---|---|
| Adda | 7,816 | Harland and Wolff | 6,000 |
| Dinteldijk | 9,399 | Harland and Wolff | 6,000 |
| Dominion Miller | 5,089 | Doxford | 3,000 |
| Dumra | 2,304 | North British Diesel | 1,200 |
| Durenda | 7,241 | North British Diesel | 4,660 |
| Dwarka | 2,328 | North British Diesel | 1,200 |
| Eknaren | 5,243 | Doxford | 3,000 |
| Glenbeg | 9,461 | Harland and Wolff | 6,000 |
| Glengarry | 9,460 | Harland and Wolff | 6,000 |
| Hauraki | 7,113 | North British Diesel | 4,660 |
| Lasseli | 7,417 | Harland and Wolff | 4,000 |
| Linnell | 7,424 | Harland and Wolff | 4,000 |
| Lochgoil | 9,462 | Harland and Wolff | 6,000 |
| Lochkatrine | 9,409 | Harland and Wolff | 6,000 |
| Pinzon | 1,365 | Beardmore | 1,620 |
| Scottish Minstrel | 6,998 | Vickers | 3,240 |
| Scottish Musician | 6,998 | Vickers | 3,240 |
| Total | 114,527 | | 69,820 |

1923.

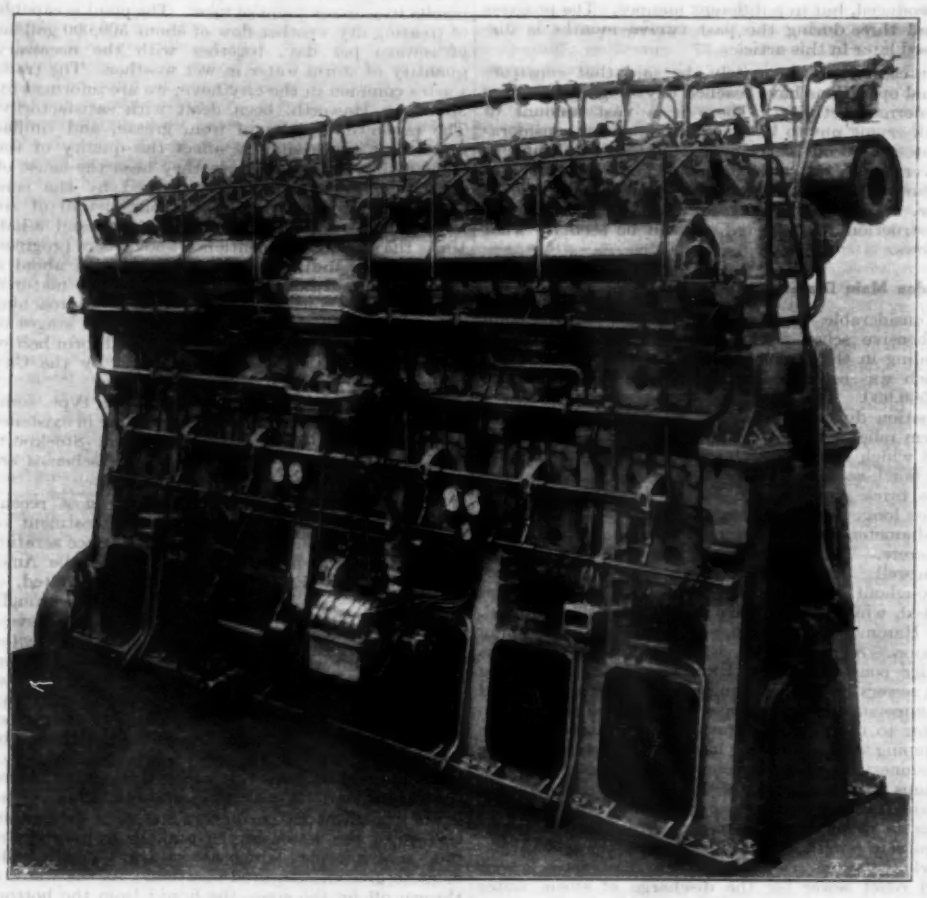
| Name. | Gross tons. | Engine builders. | Total I.H.P. |
|---|---|---|---|
| Araby | 4,936 | Harland and Wolff | 2,300 |
| Arnus | 4,185 | Swan, Hunter | 2,800 |
| Dalgoma | 5,953 | Alex. Stephens | 4,400 |
| Drechtdijk | 9,338 | Harland and Wolff | 6,000 |
| Dumana | 8,427 | North British Diesel | 4,660 |
| Ediba | 6,919 | Harland and Wolff | 3,000 |
| Gujarat | 4,320 | Harland and Wolff | 2,100 |
| La Playa | 3,682 | Cammell Laird | 4,000 |
| Laguna | 6,469 | Harland and Wolff | 3,200 |
| Margretian | 2,578 | Beardmore | 2,957 |
| Medon | 5,915 | Burmeister and Wain | 3,000 |
| Pizarro | 1,367 | Beardmore | 1,620 |
| Scottish Borderer | 6,996 | Denny Bros. | 3,100 |
| Tantalus | 7,777 | Burmeister and Wain | 6,000 |
| Total | 78,862 | | 49,137 |
| *Vessels Fitting Out.* | | | |
| Kathiawar | 4,320 | Harland and Wolff | 2,100 |
| Kistna | 1,400 | Swan, Hunter | 1,250 |
| La Marea | 3,682 | Cammell Laird | 4,000 |
| Loch Monar | 6,900 | Harland and Wolff | 6,000 |
| Sycamore | 4,000 | Richardsons, Westgarth | 3,340 |
| Tramore | 4,000 | Richardsons, Westgarth | 3,340 |
| Wellfield | 5,300 | North-Eastern Marine | 2,400 |
| Total | 29,602 | | 22,430 |

TABLE II.—*Some British Motor Ships and Marine Oil Engines of* 1923.

| Vessel. | Length. | Breadth | Depth. | Gross tonnage. | Builders. | Owners. | Type of propelling machinery. | Main engine particulars. | | | | Auxiliary machinery. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Bore. | Stroke. | R.p.m. | Total B.H.P. | | |
| | Feet. | Feet. | Feet. | | | | | Inches. | Inches. | | | | |
| Aorangi | 600 | 72 | 37.5 | 20,000 | Fairfield Shipbuilding and Engineering Co., Ltd. | Union Steamship Co., Ltd., of New Zealand | Quadruple-screw, six-cylinder, two-cycle, Fairfield-Sulzer type | 27½ | 39 | 130–135 | 12,500–14,000 | Diesel-electric and turbo blowers Sulzer engines | Two engines ready for shop trials |
| Araby | 280 | 53 | 29 | 4,936 | McMillan and Sons, Ltd., and Harland and Wolff, Ltd. | McIver and Co., Ltd. | Single-screw, six-cylinder, four-cycle, long-stroke, Harland and Wolff-B. and W. type | 29½ | 59 1/16 | 85 | 1,800 | Three 100 K.W. Diesel-electric generators | Completed |
| Arnus | 377 | 49 | 28.6 | 4,185 | Swan, Hunter and Wigham Richardson, Ltd. | Compania General de Tabacos de Filipinos | Twin-screw, six-cylinder, two-stroke, Neptune type | 17 | 35 | 125 | 2,100 | Steam and Diesel-electric, two 70 K.W. R. V. Sulzer engines | Completed |
| Arantza Mendi | 360 | 48.6 | 24.8 | 4,000 | Sota and Aznar and J. and G. Kincaid, Ltd. | Sota and Aznar | Single-screw, six-cylinder, four-cycle, long-stroke, Kincaid-B. and W. type | 29½ | 59 1/16 | 90 | 1,800 | Three 65 K.W. Diesel-electric generators | Completed |
| Cranley | 410 | 55.25 | 29 | 6,200 | Barclay, Curle and Co., Ltd., and North British Diesel Engine Works, Ltd. | Harris and Dixon | Single-screw, three-cylinder, two-cycle, double-acting, North British type | 24½ | 44 | 100 | 2,000 | Steam auxiliaries | Engine undergoing shop trials |
| Dalgoma | 447.5 | 54.5 | 32.3 | 5,953 | Alex. Stephen and Son, Ltd. | British India Steam Navigation Co., Ltd. | Twin-screw, four-cylinder, two-cycle, Stephen-Sulzer type | 26 13/16 | 43½ | 84 | 3,200 | Diesel-electric and turbo blowers | Completed |
| Dolius | 400 | 52 | 32 | 5,700 | Scott's Shipbuilding and Engineering Co., Ltd. | Alfred Holt and Co. | Twin-screw, four-cylinder, two-cycle, Scott-Still type | 22 | 36 | 120 | 2,500 | Steam and Diesel-electric, three 100 K.W. Allen-B. and W. engines | Machinery shop trials finished |
| Drechdtijk | 502 | 62 | 38.5 | 9,338 | Harland and Wolff, Ltd. | Holland-America Line | Twin-screw, eight-cylinder, four-cycle, Harland and Wolff-B. and W. type | 29½ | 45½ | 115 | 6,000 I.H.P. | Diesel-electric auxiliaries | Completed |
| Dumana | 464 | 58 | 35.5 | 8,427 | Barclay, Curle and Co., Ltd., and North British Diesel Engine Works, Ltd. | British India Steam Navigation Co., Ltd. | Twin-screw, eight-cylinder, four-cycle, North British-Diesel type | 26½ | 47 | 90 | 4,000 | Diesel-electric, three 200 B.H.P. N.B. Diesels | Completed |
| Ediba | 420 | 54 | 35.25 | 6,919 | Harland and Wolff, Ltd. | Elder, Dempster and Co., Ltd. | Twin-screw, six-cylinder, four-cycle, Harland and Wolff-B. and W. type | 26½ | 39½ | 115 | 2,400 | Diesel-electric, three 100 K.W. generators | Completed |
| Gripsholm | 550 | 74 | 42.5 | 17,000 | Armstrong, Whitworth and Co., Ltd., and Burmeister and Wain | Swedish-America Line | Twin-screw, six-cylinder, four-cycle, double-acting, B. and W. type | 31½ | 55½ | 125 | 13,500 | Diesel-electric, three 700 B.H.P. and three 500 B.H.P. B. and W. engines | Hull and machinery in progress |
| Gujarat and Kathiawar (two ships) | 384 | 48 | 36 | 4,320 | Harland and Wolff, Ltd. | Andrew Weir and Co., Ltd. | Single-screw, six-cylinder, four-cycle, long-stroke, Harland and Wolff-B. and W. type | 29½ | 59 1/16 | 85 | 1,800 | Diesel-electric, three 65 K.W. generators | One completed, one approaching completion |
| Laguna | 433 | 54 | 36 | 8,469 | Harland and Wolff, Ltd. | Pacific Steam Navigation Co., Ltd. | Twin-screw, six-cylinder, four-cycle, Harland and Wolff-B. and W. type | 26½ | 39½ | 115 | 2,400 | Diesel-electric, three 100 K.W. generators | Completed |
| La Playa | 325 | 48 | 31.75 | 3,682 | Cammell Laird and Co., Ltd. | United Fruit Co., Ltd. | Diesel-electric propulsion. Four sets Cammell-laird-Fullagar 825 B.H.P. engines | 14 | 32 | 250 | 3,300 | Auxiliary generators attached to main engines, B.T.H. electrical equipment | Completed |
| Medon | 423 | 52 | 32 | 5,915 | Palmers Shipbuilding and Iron Co., Ltd., and Burmeister and Wain | The Ocean Steamship Co., Ltd. | Single-screw, eight-cylinder, four-cycle, long-stroke, B. and W. type | 29½ | 59 1/16 | 85 | 2,400 | Diesel-electric, three 100 K.W. Allen generators | Completed |
| Margretian | 310 | 43 | 24 | 2,578 | Chas. Hill and Sons and William Beardmore, Ltd. | Owen Watkins, Williams and Co., Ltd. | Twin-screw, six-cylinder, Beardmore-Speedwell engines | 18 | 24 | 185 | 1,200 | Steam auxiliaries | Completed |
| Pizarro | 240 | 38.1 | 18 | 1,367 | William Beardmore, Ltd. | MacAndrews, Ltd. | Single-screw, six-cylinder, four-cycle, Beardmore-Tosi type | 24½ | 38½ | 120 | 1,250 | Diesel-electric, three 100 B.H.P. Beardmore-Tosi engines | Completed |
| Scottish Borderer | 425 | 57 | 33.2 | 6,996 | Denny Bros., Dumbarton | Tankers, Ltd. | Twin-screw, four-cylinder, two-cycle, Denny-Sulzer type | 23½ | 41½ | 100 | 2,500 | Steam and Diesel-electric | Completed |
| Sycamore and Tramore (two ships) | 363 | 52 | 26 | 4,000 | Furness Shipbuilding Co., Ltd., and Richardsons, Westgarth and Co., Ltd. | Furness, Withy and Co., Ltd. | Twin-screw, six-cylinder, four-cycle Richardsons, Westgarth-Tosi type | 24½ | 38½ | 125 | 2,500 | Diesel-electric auxiliaries | Approaching completion |
| Tantalus | 477 | 58 | 35.3 | 7,777 | Caledonian Shipbuilding Co., Ltd., and Burmeister and Wain | Alfred Holt and Co., Ltd. | Twin-screw, eight-cylinder, four-cycle, B. and W. type | 29½ | 45½ | 115 | 6,000 I.H.P. | Diesel-electric, four 100 K.W. B. and W. generators | Completed |

extensive Lancefield-street, Glasgow, works of Harland and Wolff, Limited, but the first Diesel engined vessel—the Lochmonar for the R.M.S.P. Company—was built and its machinery constructed at Belfast. Further arrangements are in progress at Belfast with a view to the building there of the double-acting four-cycle engines required for the large mail vessels ordered by the R.M.S.P. Company and the Union Castle Line. A motor liner for the last-named firm will, we learn, be a vessel of over 20,000 tons gross, with twin-screw machinery of approximately 20,000 indicated horse-power. In many respects she will resemble the Arundel Castle, owned by the same company. Just before the close of the year the Gujarat, the first vessel for Andrew Weir and Co.—the Bank Line—was completed at the Govan Yard, and the second ship, the Kathiawar, was launched. It will be remembered that a further nineteen motor vessels are to be built for this line. The returns show that the long stroke engine is gaining ground for medium-sized single-screw ships, and four sets of this type of engine were constructed at Harland and Wolff's works and at Kincaids, of Greenock, whilst several sets of auxiliary engines were built by W. H. Allen and Sons, Limited, at Bedford.

At Burmeister and Wain's own works in Copenhagen the chief interest centred around the experiments carried out with the single cylinder



VICKERS NEW 600 BRAKE HORSE-POWER MARINE OIL ENGINE

1000 brake horse-power double-acting four-cycle engine, illustrated in THE ENGINEER for July 20th. Other standard engines, seven in number, representing 18,150 indicated horse-power, were completed during the year for various motor ships. Three of these engines were for the vessels Medon—see to-day's Supplement—and the Tantalus. Three other sets of machinery, representing a further 9580 indicated horse-power, were finished for ships not ready before the end of the year. A new lighter type of short stroke engine, running at a speed of 150 revolutions per minute, has also been evolved by Burmeister and Wain, which should prove useful for small vessels. A further five main engines of some 8000 indicated horse-power, including auxiliaries, were built at the Götaverken Gothenburg, Sweden, of which two sets of machinery were installed in large motor-driven ore-carrying ships. This same company has also launched a motor tanker, the Zoroaster, in which the Nobel engines—described in THE ENGINEER of January 27th and February 3rd, 1922—are to be installed.

**The Beardmore-Tosi Engine.**

A type of four-cycle engine which achieved considerable success within the past year, is that which was developed from the original designs of Tosi Bros., Legnano, Italy, and which was first manufactured by William Beardmore and Co., Limited, and later taken up by Richardsons, Westgarth and Co., Limited, of West Hartlepool. At Dalmuir one ship of the year was the Pizarro—shown in our Supplement—which, together with her sister ship, the Pinzon, has performed good work in the Spanish fruit trade. A further twin-screw set of machinery of this type, with a total of 2500 brake horse-power, is under construction at Dalmuir for the Golden Cross Line of Cardiff. Experimental work has not been neglected, and the merits of the Tosi high-speed oil engine and the Beardmore-Tosi four-cycle double-acting engine are being tested. The last named engine promises to be an attractive proposition for the larger class of ship. At West Hartlepool two sets of twin-screw engines for the Sycamore and Tranmore, one of which is illustrated in to-day's Supplement, have been built, and one set of engines has been officially tested by the Marine Oil Engine Trials Committee. The sea trials are expected to take place early this year.

**The Camellaird-Fullagar Engine.**

An event of last year was the completion of the first of the three electrically-propelled fruit boats, which are in course of construction at Birkenhead for the United Fruit Company of Boston, U.S.A. We illustrate the La Playa in to-day's Supplement, and the machinery of the ship was described in our issues of October 19th and 26th respectively. The La Marca is being fitted out with her Diesel electric propulsion equipment, which was built by the British Thomson-Houston Company, Limited, and the La Perla will, it is hoped, be launched early this year. At the yard of John Brown and Co., Limited, Clydebank, twin-screw machinery of the Camellaird-Fullagar type of 2500 brake horse-power, was completed and tested for Japanese owners; while at Palmers Shipbuilding and Iron Company, Limited, a three-cylinder 3000 brake horse-power engine for a 10,000-ton oil tanker, which will be built at Jarrow, was finished. This is the largest engine yet built by the firm. David Rowan and Co., Limited, of Glasgow, constructed a set of machinery of 1500 brake horse-power, which will be installed in a single-screw ship, built on the Clyde by W. Hamilton and Co., Limited.

**The Doxford Engine.**

The shops of W. Doxford and Sons, Limited, were extended during the year, and several sets of engines are there approaching completion. One motor vessel, the Pacific Shipper, of 6290 tons gross, has been launched. The new design of engine, although based on the lines of the engines built for the successful vessels Yngaren, Ecknaren and Dominion Miller, embodies several minor improvements, including a new form of cylinder casing construction and a different cam shaft drive, giving a rather shorter engine and a small reduction in weight. In America the Sun Shipbuilding Company, Limited, has built three sets of 3000 brake horse-power four-cylinder Doxford machinery, the first engine having been used to convert the steamer County Miller into a motor ship. The other two engines have been used for two other conversion jobs on the Challenger and Bidwell respectively; these ships are 10,000 to 11,000-ton oil tankers.

**The Neptune Engine.**

The two-cycle Neptune engine, built by Swan, Hunter and Wigham Richardson, Limited, made considerable progress during the year, and besides the motor tanker Arnus, which was described in THE ENGINEER of November 2nd, a further motor ship, the Kistna, built to the order of the British India Steam Navigation Company, Limited, was launched before the end of the year. The machinery for this vessel is a single-screw six-cylinder two-cycle engine of the Neptune type, one of seven sets of engines varying from 1250 up to 3200 indicated horse-power per engine which the company has on order. The later engines are of modified design, with scavenge air pumps which replace the scavenging cylinders beneath the main cylinders, which were a feature of the Arnus type of Neptune engine.

**The North British Engine.**

The North British Diesel Engine Works at Whiteinch completed a further vessel for the B.I.S.N. Company, Limited—the Dumana—particulars of which ship are given in Table II. However, the chief event of the year at Whiteinch was the successful preliminary shop trials of a new type of sliding cylinder double-acting two-cycle engine. We illustrate this engine in one of to-day's Supplements. It is shorter and lighter than single-acting machinery of the same power—2000 brake horse-power—and these are qualities which favour its use for ships which are to be converted from steamers to motor ships, for the overall length is not greater than that of an ordinary reciprocating steam engine, and the boiler and bunker spaces which are set free when Diesel machinery is installed can be used for cargo-carrying. The engine is the first two-stroke double-acting motor to be built in Great Britain.

**The Scott-Still Engine.**

Probably one of the most interesting marine installations of the year is that which was constructed by Scotts Shipbuilding and Engineering Company, Limited, at Greenock, for the Holt liner Dolius. We illustrate the starboard engine in a Supplement to-day, and a full account of the machinery and auxiliaries for the ship will be found in our issues for November 23rd and 30th. One of the engines was tested by the Marine Oil Engine Trials Committee, whose report is shortly expected. We believe that it is the intention of Messrs. Scotts to build Scott-Still engines in standard sizes which should cover a wide field of application. The sea trials of the Dolius will be awaited with the keenest of interest.

**The Sulzer Type Engine.**

In our issue of June 1st a full account was given of the Dalgoma, built by Alexander Stephen and Sons, Limited, for the B.I.S.N. Company, Limited, an illustration of which ship is given in a Supplement to-day. On her maiden voyage, when running under special conditions through the Suez Canal, owing to the low speed of the engines, which were running with two of the four cylinders cut out, some of the pistons were cracked because there was not sufficient turbulence of the cooling water in the piston crowns. After the peculiar circumstances under which the engines were run were examined, arrangements were made to avoid future trouble from such a cause. Another British installation of Sulzer engines was that built for the Scottish Borderer by William Denny and Brothers, Limited, at Dumbarton. Particulars of the machinery of this oil tanker are given in Table II. At the Fairfield yards good progress has been made with the four engines for the motor liner Aorangi, and a few notes concerning the design of the machinery for this ship were given in our issue of December 14th. Particular care has been taken to stiffen up the bedplate and tank top so that vibration is avoided, and very ample bearing surfaces have been adopted throughout the design. The piston cooling system is slightly modified so that the piston crowns are "drowned" with cooling water, and other interesting features have been introduced. There is no doubt, in our opinion, that the Fairfield-Sulzer engines are among the finest of their type we have yet seen. Other Sulzer-type marine engines are under construction, we understand, at John Brown and Co., Limited, Clydebank, and Armstrong, Whitworth and Co., Limited, at Newcastle. At Ramage and Fergusons, of Leith, two two-cycle engines of 800 brake horse-power are in course of erection in a private yacht which is being built for an Egyptian owner. These engines are, we understand, among the largest ever fitted into a yacht, and they were built at Winterthur, at which works twenty-nine two-cycle marine engines, totalling 12,500 indicated

horse-power, are under construction for submarines, tugs, small craft and general marine purposes.

**The Vickers Engine.**

The Barrow Works of Vickers, Limited, were engaged during the year upon two new types of oil engines. The basis of the designs was the engine which was installed in oil tankers built for the Anglo-American Oil Company, Limited, and Tankers, Limited, during the years 1920–1922, six of which ships continue to give good service. We show, on page 9, one of the new engines, a smaller six-cylinder motor designed to develop 600 to 650 brake horse-power at 150 to 160 revolutions per minute. One of these engines was recently delivered by Vickers to the Mitsubishi Zosen Kaisha, Limited, and is to be used for a vessel built by that company for service on the inland sea of Japan. Another engine now being erected at Barrow is the eight-cylinder 3000 brake horse-power unit for a Donaldson cargo vessel. The speed of the engine will be about 110 revolutions per minute, and the cylinders are 30in. in diameter with a stroke of 45in. The trials and sea-going results of this ship will be awaited with interest. The work at Barrow also included some high-power engines for naval work and submarine engines for Spain. A number of submarine engines of the Vickers design are to be built under licence by Augustin Normand, of Havre, for the French Government, and during the year the Japanese Navy accepted submarines with the Vickers' type of engine manufactured by the Mitsubishi Zosen Kaisha, its sole licencees in Japan.

**The Werkspoor Engine.**

This type of engine continues to make advances, and the North-Eastern Marine Engineering Company, Limited, completed two 1400 indicated horse-power North-Eastern Werkspoor engines for the vessel Wellfield, of Newcastle. Another interesting set of machinery under construction is an eight-cylinder single-screw engine of 2500 shaft horse-power, with cylinders 28¾in. diameter and a stroke of 51½in. This large engine is to be fitted into a single-screw 400ft. motor ship, built to the order of James Chambers and Co., Limited, of Liverpool. At the works of Hawthorn, Leslie and Co., Limited, St. Peters, Newcastle-on-Tyne, two sets of 1400 indicated horse-power machinery of the Werkspoor type were completed and one is undergoing tests by the Marine Oil Engine Trials Committee. In the course of a recent visit to Amsterdam, we saw the new double-acting four-cycle experimental engine which Werkspoor is building in conjunction with one of its British licencees. This engine is expected to start its trials shortly.

**Marine Oil Engine Trials.**

Brief reference has already been made to the work of the Marine Oil Engine Trials Committee, appointed by the Institution of Mechanical Engineers and the Institution of Naval Architects. The Committee has started the actual testing work, and three types of machinery—the Richardsons-Westgarth-Tosi, the Scott-Still and the Hawthorn-Leslie-Werkspoor engines—have been dealt with. Sea trials will, be begun early in this year. Several owners and builders have offered engines and ships for further tests, and it is to be hoped that no important type of engine will be omitted.

**A New Type of Beardmore Engine.**

In connection with the discussion of Professor A. L. Mellanby's paper on "Clyde Marine Oil Engines" before the Institution of Mechanical Engineers in London, we described in our issue of December 7th a new type of high-power two-cycle hot-bulb engine, which has been constructed by William Beardmore and Co., Limited, at its Coatbridge works. This engine, it is claimed, is simple in construction, and has a fuel consumption which closely approaches the Diesel engine. The first installation of Beardmore-Speedwell engines was fitted to the twin-screw boat Margretian, built by Charles Hill and Sons, Limited, for Watkin Williams and Co., Limited, of Cardiff. The Margretian is a 310ft. vessel of 6525 tons displacement. Her propelling machinery is placed aft and comprises two six-cylinder engines each designed to develop 600 brake horse-power at a speed of 185 revolutions per minute. The cylinders have a bore of 18in. with 24in. stroke, and each engine has an overall length of 22ft. 6in., a width of 5ft. 6in., and a height above floor plate of 7ft. Including the fly-wheel silencer and exhaust pipes the total weight of each engine is about 45 tons. Each main engine drives its own circulating and bilge pump, as well as the lubricating oil pump and a fuel transfer pump. An exhaust gas heat recovery boiler of the Spencer-Hopwood type, with auxiliary oil firing, is provided for working the auxiliary machinery.

**Diesel Engines with Reduction Gears.**

The utilisation of the internal combustion engine, in combination with speed reduction gears, has during the year received the attention of several marine engineers. At the Olympia Shipping and Machinery Exhibition a new type of geared Diesel engine installation was shown in model form by the Parsons Marine Steam Turbine Company, Limited, Wallsend-on-Tyne. The drive from the engine was transmitted to the propeller through the medium of an elastic frictional coupling, a friction clutch and reduction gearing. An experimental unit has, we understand, been constructed, and it is hoped to install an arrangement of the type described in a vessel. In America several general installations were built by the Falk Corporation of Milwaukee, and they are, we understand, operating satisfactorily. A similar arrangement has been tried on German motor ships, and the latest developed in that country takes the form of Diesel engines combined with a Föttinger transformer and speed reduction gearing.

## Sanitary Engineering in 1923.

NOTHING of absolute novelty occurred during the year in connection with sanitary engineering. The only outstanding feature is the development of the three variants of the treatment of sewage by agitation and aeration, *i.e.* (*a*) by the diffused air—or, as it was originally named, the activated sludge—process; (*b*) by the bio-aeration process, and (*c*) by the surface aeration process. By all these processes what is termed "activated sludge" is produced, but in a different manner. The progress of all three during the past twelve months is discussed later in this article.

It cannot, unfortunately, be said that constructional operations have reached anything approaching to normal activity. There is a vast amount of work crying out to be done, but financial considerations still stand in the way of its accomplishment. Nevertheless, a not inconsiderable quantity of preliminary preparation was carried out during the year, and, in the aggregate, a good deal of actual construction was effected, as will be seen by what follows.

**London Main Drainage and Sewage Disposal.**

Considerable progress was made with the comprehensive scheme of new works for the relief of flooding in the County of London, the total cost of which was estimated on a pre-war basis as about £2,500,000. The following works were under construction during the year:—(*a*) The North-Eastern storm relief sewer, which is about 4 miles in length, and which is designed for the relief of floodings in the north-eastern portions of the county. It consists of a brick sewer 8ft. to 9ft. in diameter, about 2½ miles long, the remaining 1½ miles being 11ft. 4in. in diameter and constructed of cast iron lined with concrete. The outlet into the river Thames is at Shadwell. The sewer is constructed in tunnel throughout and the tunnelling work has been completed, while the auxiliary works are well advanced. (*b*) Hammersmith storm relief sewer and pumping station. A new storm water pumping station is under construction at Hammersmith for relieving the sewers in the low-lying parts of Kensington and Hammersmith. The connecting sewer to bring storm water to the pumping station is completed and the pumping station building has also been built, and the machinery is being erected. When complete, the pumps will be capable of dealing with 1000 tons of storm water per minute. (*c*) Wandle Valley sewer. This is a new relief sewer in Wandsworth, about 2 miles in length, and it is being constructed in brickwork of various sizes up to 7ft. in diameter. A weir and relief sewer for the discharge of storm water into the river Wandle will be provided. The work was almost completed. (*d*) Charlton storm relief sewer. This is about ½ a mile long, and is being constructed in order to relieve the southern high-level sewer in time of storm. It is built largely of reinforced concrete and has an outlet into the river Thames at Charlton. This work, also, was practically completed; and (*e*) South-Western storm relief sewer. This sewer is designed to relieve the Effra sewer at Brixton, as well as other important sewers, and discharge storm water into the river Thames at Nine Elms. The whole of the sewer is to be constructed in tunnel, the greater part of cast iron and concrete. The total length is about 2¾ miles, and some progress was made with the work. With regard to sewage disposal, the London Council's steamers, which convey sewage sludge to sea, have been carrying out that work continuously for more than thirty years, and with a view to replacing the older vessels a new steamer of 1500 tons capacity was obtained from Wm. Beardmore and Co., Limited. Experiments on the treatment of London sewage by the activated sludge process are being carried out on a small scale.

**Sewage Treatment by Agitation and Aeration.**

*The Activated Sludge or "Diffused Air" Process.*—Considerable progress has been made during the last twelve months with the activated sludge process of sewage purification. The following plants have been installed during the past year and are now in operation:—(1) Withington, for the Manchester Corporation, treating one million gallons of sewage, dry weather flow, per day. This installation is referred to in some detail below; (2) Hanley, in the Stoke boroughs, treating over one million gallons of sewage, dry weather flow, per day; (3) Chilwell depôt, near Nottingham, for H.M. War Office, treating the whole flow of sewage from 2000 people; (4) Cadbury Bros., Limited, treating trades waste and domestic sewage from one of their factories; (5) the United Dairies, Limited, treating dairy wastes from one of its factories, as well as several plants in Ontario, Canada, and in Holland.

The plant to treat the whole flow of sewage from Reading, with a calculated future population of 120,000 and an average dry weather flow of 3½ million gallons of sewage per day, was commenced early in this year, and the construction of the tanks is now well in hand. It is hoped that the plant will be in operation by the autumn of this year. It will be the largest plant on the "diffused air" method in England. A plant operating on this principle is also being installed for J. S. Fry and Sons, Limited, of Bristol, at their new factory at Somerdale, this being a first unit to treat sewage from a population of 1200 people. The Ministry of Health has sanctioned loans during the past year for activated sludge plants to be installed at Coventry, Hertford and Burslem.

*The Bio-aeration Process.*—The large bio-aeration unit at Sheffield, which we have previously described, has been in continuous operation during the last three years, and has given highly satisfactory results from every point of view. The plant is capable of treating dry weather flow of about 500,000 gallons of sewage per day, together with the necessary quantity of storm water in wet weather. The trade wastes common in the city have, we are informed by Mr. John Haworth, been dealt with satisfactorily. The presence of salts of iron, grease, and similar matters at times slightly affect the quality of the effluent, but in no case have they been the cause of contravening the standards required by the controlling rivers authority. The construction of six large units, each of approximately two and a-half times the size of that mentioned above, is in progress. One of these units was put into operation about a month ago, and it is rapidly coming into a matured condition. A further similar unit is approaching completion, and the others are in various stages of construction. The six units mentioned form half of the scheme of twelve units approved by the City Council.

Plants on the Sheffield or bio-aeration type, some in operation, some under construction, are in existence at Rotherham, East Ham, Wakefield, Stockport, Mansfield, Barnsley and Paris, while schemes are being prepared in several other towns.

*The Surface Aeration System.*—The most recent development in the activated sludge treatment of sewage is that which is known as the surface aeration process, and which is being exploited by the Ames Crosta Sanitary Engineering Company, Limited, of Nottingham. In it, aeration and agitation are brought about by mechanical means by the use of a device for which it is claimed that both processes are effected efficiently and with but small expenditure of power. The plant consists of one or more tanks, with cone-shaped bottoms, the angle being sufficient to permit the sludge to fall to the bottom of the inverted cone. In the centre of the tank there is an uptake tube which terminates about 6in. from the bottom of the tank, and which is fitted with a revolving bladed cone at the top. When this cone is rotated the water is thrown off at its periphery, and as it strikes the surface of the water in the tank large numbers of bubbles are formed which are said to be quite sufficient to give the required aeration. As the water is thrown off by the cone, the liquid from the bottom of the tank is drawn up the central tube to replace that thrown off and splashed in the tank, a constant circulation of the contents of the tank being thus achieved. The tank is divided into two compartments by a thin shell wall so as to form inner and outer compartments. The inner compartment is used for agitation and circulation, while the outer compartment is in a state of quiescence and provides a settling area in which the sludge settles from the purified effluent and passes down the cone of the tank into the agitating area to be re-circulated, thus avoiding the cost of pumping the returned sludge. The incoming crude sewage is admitted to the aerating or agitating area and the purified effluent passes from the settling area over a sill.

Satisfactory results are, we understand, now being obtained with this process, and installations are in operation or being constructed at the following towns:—Bury, where there is a tank capable of dealing with 50,000 gallons per day, in operation, and another tank capable of dealing with 1,250,000 gallons per day, nearing completion; Bolton, where there is a tank capable of dealing with 750,000 gallons per day, in operation; Birmingham, where there is a plant capable of dealing with 2,000,000 gallons per day, in operation, and extensions proceeding; Epsom, where there is a plant capable of dealing with 500,000 gallons per day, in course of construction; and Brighouse, where there is a plant capable of dealing with 1,000,000 gallons per day, in course of construction. Several smaller plants are in operation, both at home and abroad, and from them data have been obtained for installing large scale plants.

**Manchester's New Activated Sludge Plant.**

In August Manchester completed the construction of a plant designed to treat a dry-weather flow of 1,000,000 gallons per day, and storm water up to three times that volume. The installation occupies a total area of, approximately, 1450 square yards, the aeration chambers covering 1200 square yards and the settlement tank and effluent pond 250 square yards. It consists, essentially, of an aeration tank of a total water-holding capacity of, approximately, 325,000 gallons, and a settlement tank, the capacity of which is about 85,000 gallons. The aeration tank is 180ft. long by 60ft. wide, and it is divided longitudinally to form two independent chambers, one situated on each side of a common central channel, for the return and re-aeration of the sludge. Each aeration chamber, 177ft. long by 20ft. wide, has a capacity of 145,000 gallons, and is divided by two longitudinal walls, furnished with port-holes, to provide an aeration channel 530ft. long by 6ft. 3in. average width, and approximately 7ft. deep below water level. Cross baffle walls, each with 1ft. 6in. by 2ft. openings, fitted with deflectors, are constructed at intervals of about 35ft. along the whole length of these aeration channels. The sludge return and re-aeration channel, which is 160ft. long by 6ft. average width, and is 5ft. 6in. deep below water level, has a capacity of 35,000 gallons, and is also provided with cross baffle walls. Aeration is effected through lines of diffusers placed alongside the inclined footings of the divisional walls on one side only of the channels. The diffusers each measure 3ft. by 4½in. overall, so that their total area is, approximately, one-seventeenth of the aeration tank area. The ratio of actual diffusion area to total tank area is, approximately, 1 to 23. There is an overhead system of air pipes, and the air is admitted to the diffusers through a series of down pipes, one to each diffuser. The tank may be sectioned, so far as air supply is concerned, by valves on the air mains, and each down pipe is fitted with a needle and orifice control so as to secure uniform air distribution. The settlement tank is a deep pyramidal tank with four pockets, 36ft. by 36ft. by 20ft. 6in deep from water level to the apex of the pyramid. A 24in. pipe, to convey the mixed liquor, passes from the outlet of the aeration tank to a central distributing chamber, which latter is in communication with four Clifford inlets arranged over the centres of the pyramidal pockets. Provision is made for the discharge of the deposited sludge by hydrostatic head through 6in. pipes into a small central sludge channel communicating by a 15in. pipe with the re-aeration channel. The sewage enters the plant through a small mixing chamber, into which is discharged the return activated sludge, and passes thence to the aeration chambers. The mixed liquor ultimately discharges over cills into a narrow shallow lateral channel prior to passing to the settlement tank.

**The Walshaw System of Disposal.**

Developments during the last few months in connection with the Walshaw system of sewage disposal have been of an interesting character. German scientists and engineers have been experimenting with tanks, constructed at Erfurt, in accordance with the Walshaw designs, and from the latest information received the trials have been of such a nature that it has been decided to employ the system to deal with the whole of the sewage of that city, which contains about 130,000 people. This scheme is designed for the production of power from the gases liberated. At the present time a demonstration plant is being constructed at Long Ashton, just outside Bristol, where the Rural District Council has placed its sewage farm at the disposal of the Septic Gas Company of Australia, Limited, for the purpose. The tank in course of erection is to deal with the sewage of about 1200 people, and the gases liberated in the tank will, it is anticipated, be sufficient to drive a 10 brake horse-power gas engine to demonstrate the possibilities of pumping, lighting, &c. This scheme will, we understand, be completed in about two months time. A Walshaw installation is at the present time being installed by the Rockhampton City Council—Queensland—at a cost of £28,000, that amount having been granted by the Queensland Government for the purpose, owing to the strong recommendation received from a United States sanitary expert, who was in Australia to advise the Commonwealth authorities on general sewerage matters. This plant will, we gather, serve the needs of about 20,000 people, and the power produced is to be utilised for the lighting of the whole City of Rockhampton with electricity.

**Leeds.**

The extensive sewage disposal works, the construction of which was begun as long ago as 1910, but which was interrupted during the war years, made considerable progress during the past twelve months, capital expenditure amounting to about £200,000 having been incurred. The chief items were: (1) Putting in an installation of electric power from the city mains for all power purposes, both in connection with the pumping of the sewage, stormwater, and sludge, and for driving the sewage distributors on the percolating filters; (2) the practical completion of 12 acres of percolating filters. The distribution of the sewage upon 6 acres of this area is governed by electric power-driven distributors, the distributors on the remaining 6 acres being travelling machines driven by the head of sewage applied to the filter. Contracts were let for the construction of a further 18 acres of percolating filters, which will make the total area when completed 30 acres; (3) concurrently with this work on the sewage works site, contracts were in progress upon the construction of a main intercepting sewer traversing through the heart of the city from west to east. About 3 miles of this sewer and its branches were completed, the contracts for the remaining 5 miles were let and the work is now in progress. The sewer is being almost entirely constructed in tunnel; and (4) the low-level pumping station at Knostrop was formally opened on October 1st.

**Works in Hand and in Contemplation.**

The new works of the West Kent Main Drainage Board, to which reference was made in our last annual article, were proceeded with during the year; but progress was slow owing to the unfavourable nature of the ground met with. The new works of the Grays, Tilbury and Thurrock Sewerage Board, of which we have several times made mention, are now practically completed. The main sewer, which starts at Purfleet and finishes beyond Tilbury Fort, has been successfully laid. Very great difficulties were experienced in the construction of this sewer through the Essex Marshes, but they were successfully overcome. The power-house is finished, the machinery is installed, and the bacterial purification works are nearing completion.

The laying of Folkestone's new outfall sewer proceeded satisfactorily. By it, it is proposed to take all the sewage of the town from the east end of Fish Quay to Copt Point, some half-mile to the east, in a 48in. cast iron main. At Copt Point there is to be a large storm overflow and screening chamber, and from it the sewage is to be conveyed to low-water mark by a 36in. cast iron main, which is supplemented by a second 36in. main to act as an overflow. In addition to the foregoing there are considerable supplementary works, intended to relieve the existing sewerage arrangements of the town, and consisting of a new 15in. cast iron sewer over the whole length of the Fish Quay, and a double 12in. sewer along the greater part of Tontine-street. Up to the present practically all the 15in. main has been laid on the Quay, and nearly all the manholes, &c., completed. Two-thirds of the excavation for the overflow chamber have been got out, and a start has been made with the laying of the 12in. sewer. Falmouth has under consideration a new sewerage and sewage outfall scheme which will, it is estimated, cost about £90,000. So far, however, no decision has been arrived at.

During the year Manchester let a contract for 2 miles of 12ft. diameter main sewer, and advertised another contract for a further length of sewer, which will be commenced this year. In consequence of complaints by the County Authorities, the Corporation of Leicester is having prepared for its consideration reports on a scheme involving additional pumping plant, storm tanks and bacterial purification works. An interim report was presented by a committee appointed by Calcutta to investigate the serious position which had arisen owing to the silting up of the Bidyadhari River, which serves as the outfall for the drainage system of Calcutta. The report showed that the trouble originated in the construction by unauthorised persons of embankments in the spill area, which had had the effect of interfering with the free flow of the tides. It was recommended, as a temporary measure, that the upper reaches of the river should be dredged and the spill areas extended. Loughborough has in hand a scheme for extending its disposal works, which includes the construction of additonal storm-water tanks and the installation of further pumping machinery. The Ministry of Health held an inquiry into the application of Worcester for permission to complete its activated sludge plant to deal with the whole of the sewage of the city. The Newcastle Corporation sought sanction to borrow £64,767 for a main drainage scheme at Heaton and Walker. The proposal involves an outfall into the Tyne. Grimsby was engaged in laying new sewers in the Weelsby and Old Clee districts. Chorley discussed a scheme for alterations and extensions at its Common Bank sewage works. Skegness decided to modernise its disposal works at a cost of some £15,000. Swindon practically completed the construction of twenty-one bacterial purification beds, 70ft. in diameter, together with storm-water tanks, &c. The new works are, we believe, to be put into service this month. Blackburn is converting its contact beds into sprinkler filters. Hornsey completed the reconstruction of its old outfall sewer, which was laid in 1871–2. The new work involved the expenditure of some £96,000. Brighton decided to construct a new sea outfall, and to install additional pumping plant. Bognor completed the installation of new outfall works, including the provision of electrically driven Stereophagus pumps.

The important drainage scheme at Portsmouth, to which we referred in our last annual article, was nearly completed. The work involved the installation of four 20in. centrifugal pumps, each driven by a 180 horse-power electric motor and designed to deliver 10¼ million gallons of sewage per day against a head of 70ft., together with a pump-house and screen and dredger pits. Furthermore, the six existing 42in. sea outfall pipes have all been fitted at the outlets with Johnson-Boving valves controlled from a new power-house erected at Fort Cumberland. The valves have, so we understand, been working satisfactorily for some months, and they effectually prevent the "tailings" of the sewage, which, before they were fitted, amounted to a considerable percentage of the dry weather flow.

## Bombay Water Supply—Tansa Completion Works.

WE have just received the following summary of the work done during the past year in connection with the Tansa completion works for Bombay water supply. These works were described at length in our issue of March 23rd last:

*Surveys and Land Acquisition.*—Extensive surveys were made in Bombay Island along the proposed route of the 57in. pipes, and details of all important underground works were obtained. Possession of private lands in the Thana District required for the pipe track and the Kasheli bridges was given.

*Tansa Outlet Well.*—The excavation for the Tansa Outlet Well was completed, and fair progress is now being being made. The masonry on the north side is half completed, and the four 48in. diameter outlet pipes were delivered and built in place. This work is being carried out by the Deccan Land and Building Company, at a cost of £24,000.

*Sluice Valves and Venturi Meters.*—Delivery of the large number of 48in., 36in. and 24in. sluice valves was maintained by the contractors, Blakeborough and Co., Limited, in a very satisfactory manner. The two 57in., one 48in. and one 60in. Venturi meters were also delivered by the contractor, Worthington-Simpson, Limited, well within the contract time.

*Kasheli Pumping Plant.*—The engines for the Kasheli pumping plant were delivered by the contractor, Worthington-Simpson, Limited, but owing to the complete change of method in carrying out pipe-laying operations which had been decided upon, the pumping plant will not be required to be erected in its temporary position at Kasheli.

*Tansa Filtration.*—Considerable doubt having been expressed as to the necessity of filtering the water from Tansa Lake, now that a large proportion of it will in future be conveyed from the lake to the consumer in pipes, Sir Alexander Houston and Lieut.-Colonel W. W. Clemesha were consulted on the subject, and proposals for filtering 90 million gallons per day will shortly be submitted to the Corporation by the Special Engineer.

*Sion Reservoir.*—Plans and detailed estimates have been prepared and approved for the construction of a 6 million gallons service reservoir on Sion Hill, and tenders for this work will probably be invited shortly.

*Pipe Track.*—Good progress was made in the work of constructing the embankments and cuttings—27ft. in width at formation level—about 90 per cent. of the 45 miles length being completed. Progress with masonry work in bridges and culverts was very slow, but over 30 miles of track were, at the end of the year, ready for laying the 72in. diameter steel pipes upon, the remaining lengths being well in hand. The alignment of the pipes through Bombay Island was definitely determined, but it is not intended to begin laying pipes in this section until most of the length between Kasheli and Tansa has been completed. This work is being carried out by the Tata Construction Company, at a cost of £630,000.

*Steel Pipes.*—Messrs. Braithwaite and Co.'s factory at Mulund for the fabrication of the pipes was completed and equipped with all necessary machinery, and at the beginning of December about 5 miles of 72in. diameter pipes had been manufactured, transported to site and laid. Reinforced concrete hutments for the firm's labour staff—900 rooms—had been built and occupied, and up-to-date housing accommodation for the managing and constructional officers was built and taken into use. Over 50,000 tons of steel plates, prepared ready for pipe fabrication, had been sent out from Dorman, Long and Co.'s works and delivered at the Mulund factory. Locomotives, special wagons for the transport of the pipes, travelling goliaths, hydraulic riveting and pneumatic caulking plant had all been delivered and taken into use. The work of supplying and laying the 80 miles of 72in. diameter pipes, 28 miles of 57in. diameter and 3 miles of 60in. diameter, is being carried out by Messrs. Braithwaite and Co. for the Bombay Corporation, at a cost of £2,050,000.

*Kasheli Bridge.*—Borings were taken across Bassein Creek and the most suitable site for the bridge determined. Messrs. Rendel, Palmer and Tritton, the consulting engineers in London appointed by the Corporation to examine and approve the design for the superstructure, have completed their task, and the construction of the girders is in hand. This bridge is 1800ft. long and 60ft. wide, and comprises thirteen spans. It is to be carried on concrete piers, 14ft. diameter, and is being constructed by Braithwaite and Co., at an estimated cost of £300,000.

*Kasheli North Bridge.*—This bridge, 60ft. in width, consists of ten spans of 43ft. each, and is being erected departmentally at a cost of £26,000. The piers are 12ft. diameter, of concrete, hexagonal in section, and one-half of them had been completed at the beginning of December. The remainder, it is hoped, will be finished by next June.

*General.*—The works, as a whole, are being carried out to the plans and under the supervision of the Special Engineer appointed by the Bombay Corporation (Mr. H. J. Trivess Smith, M. Inst. C.E., M. Inst. M.E.), at a total cost of £3,500,000. It is confidently expected that they will be completed and taken into service by the end of 1925.

## The Physical and Optical Societies' Exhibition.

THE exhibition of electrical, optical and other physical apparatus, which is held annually at the Imperial College of Science, under the auspices of the Physical and Optical Societies, is always of considerable interest. Every year new scientific instruments and appliances are shown, but, of course, some of them have little connection with engineering. A special feature of this year's exhibition, which was opened on Wednesday of this week, was the display of wireless goods. Many of the latest thermionic valves for reception and transmission were on view, including, the new low-consumption dull emitter valves. The Metropolitan-Vickers Electrical Company was among the wireless exhibitors, and several other firms which we have not noticed at this exhibition before were also in evidence.

One of the firms that generally presents something new at this exhibition is the Cambridge and Paul Scientific Instrument Company, of Cambridge, and the new exhibits on this occasion consisted of a stress indicator, a recording anemometer, a vibrograph, and a simple drum camera, which will record tests made in the laboratory and in the workshop.

The Cambridge stress recorder, shown in Figs. 1–3, is a light, robust instrument for the measurement of stresses in bridges and other structures. The diagrams are obtained by direct mechanical means, and are recorded upon transparent celluloid. This material, when acted upon by a stylus of suitable formation, is susceptible to slight deformation, its optical characteristics rendering any point on an enlarged image of the diagram readable with a high order of accuracy. Free vibrations of high frequency are thus recorded with exceptional clearness and exactness. The instrument consists of an H-section frame A—Fig. 1—at one end of which are two fixed points B of hardened steel, while at the other end there is a single point C carried upon a spring arm R, which is connected through a link L to a lever M, pivoted at G and carrying the stylus F at its upper extremity. Any displacements of the point C, attributable to stress changes in the structure under test, are reproduced on a magnified scale by the stylus, which traces a record on a strip of transparent celluloid K. The celluloid strip is moved past the stylus, by means of clockwork mechanism contained in the casing H, at a rate which can be adjusted within wide limits by rotating the milled head J. An independent zero line is also traced on the inner surface of the celluloid strip by a second stylus controlled by an electro-magnetic time or position-recording device. The zero position of the stress-recording stylus can be adjusted by means of the head D. When records are not being taken, the spring arm R is secured by the clamp N, so that the steel point C is rigidly held at a distance of 10in. from the two points B at the other end of the frame. The instrument is attached to the structure under test by means of the bolt E or other clamping device.

The clockwork mechanism driving the celluloid strip is set in motion and stopped by an electrical device controlled from a distance by means of a contact-making key operated by hand. If required, the key can be arranged for automatic operation. The time-marking device comprises a tuning fork, having a period of $^1/_{10}$ of a second, which controls the zero-marking stylus through the intermediary of an electro-magnet. This is also operated from a distance, and can be arranged to give position records instead of time records by using suitably placed contacts, thus enabling the stress in the structure under test at various positions of the moving load to be recorded automatically. If desired, a number of recorders may be operated from one standard timing device. The records made by the instrument are of small dimensions, and they consist of permanent indentations made by the stylus upon the celluloid surface. The lines forming a diagram are clearly defined, and will bear considerable magnification. The diagrams can be examined by means of a microscope, or direct enlargements from the actual diagrams can be obtained by photographic methods, by a *camera lucida*, or by projection upon a screen or by tracing. A light and portable microscope, fitted with a graticule, has been designed for use with the instrument. The microscope has a variable magnification, and the graticule is so arranged that the instrument can be set to read directly in $^1/_{10}$ of a ton per square inch, provision being made for adjustment to cover the different elastic strengths of the various materials tested. Readings can be repeated with an accuracy to 0.01 mm. (0.0004in.).

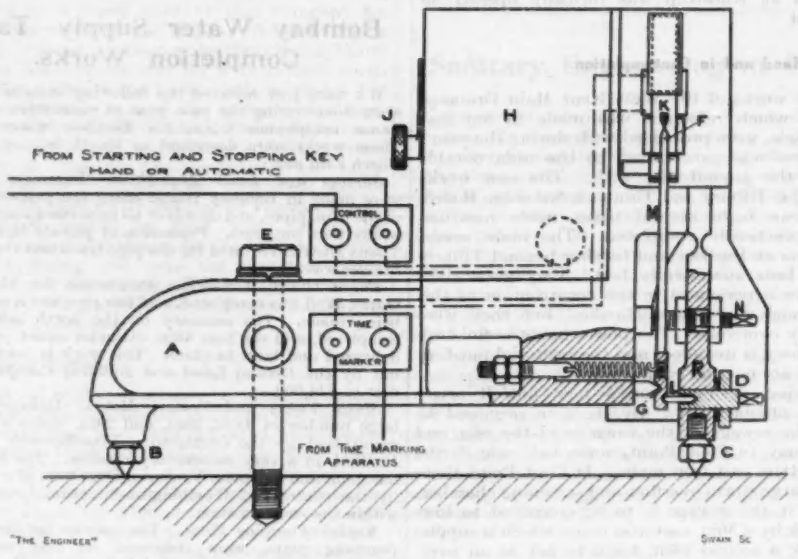



FIG. 1—ARRANGEMENT OF THE CAMBRIDGE STRESS RECORDER

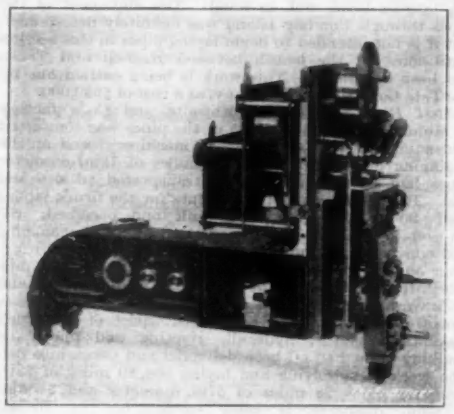


FIG. 2—CAMBRIDGE STRESS RECORDER

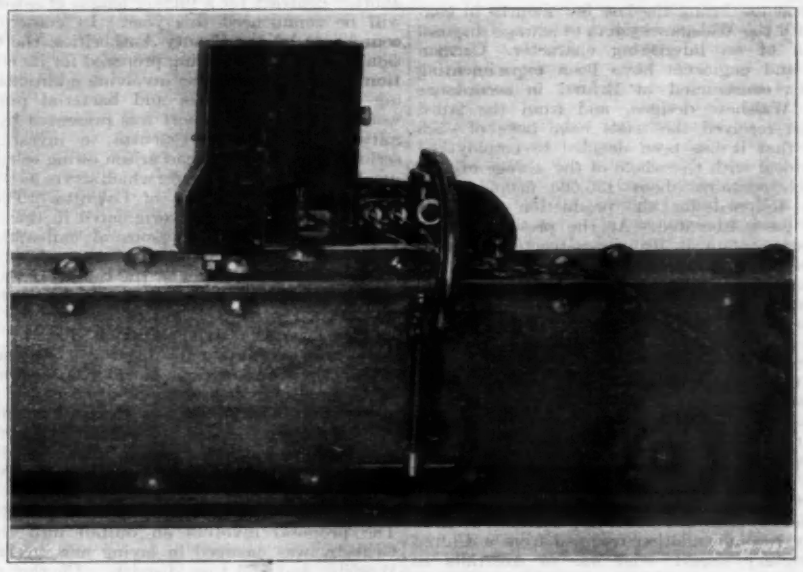


FIG. 3—THE STRESS RECORDER MOUNTED ON A GIRDER

The Cambridge Vibrograph, shown in Fig. 4, works on the same general principle as a seismograph, but a micro-record is produced on transparent celluloid with moderate mechanical magnification. As in the case of the stress recorder, the records may be examined immediately by means of a microscope, or they may be photographically enlarged.

The electrical recording anemometer shown in Fig. 5 was also exhibited by the Cambridge and Paul Instrument Company. The principle involved is an application of the well-known condenser discharge method applied to a standard Robinson anemometer. The records are taken on a standard thread recorder. A record is obtained every minute or half-minute, and a true mean reading during the last 15 sec. is obtained on the galvanometer. The advantages of the system are that only two dry cells are required to work the instrument for months, the records can be taken at very great distances from the anemometer, the resistance of the connecting cables does not affect the results, and on a gusty day a correct indication of the mean strength of the gustiness of the wind is obtained.

The new primary battery which has recently been introduced by Darimont Electric Batteries, Limited, of 536, Salisbury House, E.C. 2, was exhibited by this firm. This battery, which is very suitable for heating the filaments of dull emitter thermionic valves, gives a pressure of 1.6 volts, which is claimed to be well maintained on a continuous discharge, and there is little variation in the internal resistance. Other claims for this battery are that there is no loss of zinc when the cells are on open circuit, the cells are easily re-charged, and there is no trouble arising from the diffusion of the liquids.

Perhaps the most important exhibit of Evershed and Vignol's, Limited, of Acton-lane Works, Chiswick, was the firm's new constant-pressure "Meg" insulation tester, which combines the advantages of a constant-pressure generator with light weight and compactness. The provision of a constant-pressure clutch enables circuits having considerable electrostatic capacity to be tested, and the risk of damaging insulation by excessive pressure is eliminated. Another exhibit of interest to engineers was the Dionic water tester. By taking a measurement of the electrical conductivity of the water, this apparatus enables the amount of inorganic impurity in the water to be accurately determined. There was also a "Ductor" potential ohmmeter for the measurement of low resistances from a few ohms down to 1 microhm, workshop ohmmeters, recording instruments, portable indicating instruments, a leakage indicator and generators for wireless transmission. These generators have been designed to give a steady uni-directional high-tension current, suitable for wireless transmission. A small generator of this type is similar, in many respects, to the firm's "Megger" generator, but modifications have been introduced to minimise the ripple and consequent humming which is set up by some wireless generators. The output of this hand-operated generator is about 30 milli-ampères at a pressure of 1000 volts. A similar motor-driven generator is also made.

Wickman's patented adjustable calliper gauges for plain and threaded work were exhibited by Alfred Herbert, Limited, of Coventry. These gauges can be set for extremely fine limits, and can be adjusted to compensate for wear. A small ball-hardness tester shown has been designed for ascertaining the hardness of thin and frail objects which cannot be tested on the standard Brinell machines. It employs a small ball of from 1 mm. to 5 mm. in diameter, with loads up to 50 kilos. It is claimed that the apparatus can be used for testing articles .010in.

thick, and can be employed for testing case-hardened work, edges of cutting tools, wire, thin tubes, &c.

The Igranic Electric Company, Limited, of 149, Queen Victoria-street, was showing a good collection of its well-known wireless products, including honeycomb tuning coils, "gimbolder" coil holders, variometers and vario-couplers, intervalve transformers, filament rheostats, telephone transformers, and so forth.

The Elverson Oscilloscope, which is an instrument for investigating the behaviour of machinery under actual working conditions, was exhibited by Herbert Kennedy and Co., of 47, Victoria-street, S.W. 1. A lamp is made to give a momentary flash

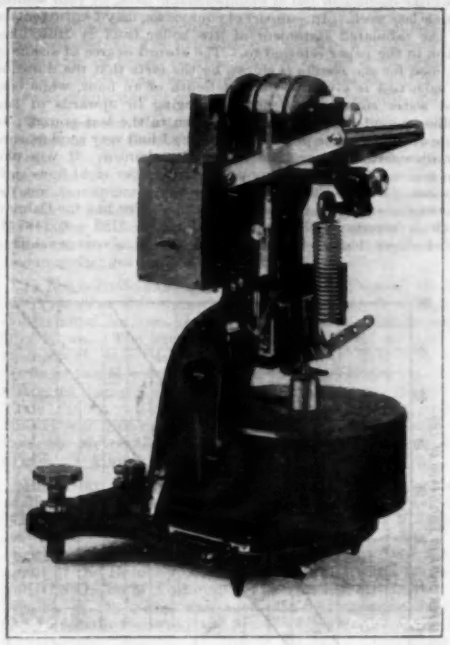


FIG. 4—THE CAMBRIDGE VIBROGRAPH

of light of great brilliancy, and the light is caused to rise to its maximum intensity and to disappear instantaneously. The light is synchronised with the movements of the machine, which is under observation in a partly darkened room, and by means of a change-over switch the flash is timed to occur either at exactly the same point per cycle or one-hundredth of a cycle later per revolution. On account of persistence of vision, the machine then appears to be stationary, although it is actually moving, or optically moving, at one-hundredth of the actual speed. In either case, by moving a sliding contact, the instrument can be made to give two or four flashes per revolution and to show two images of the machine 180 deg. apart, or four images 90 deg. apart. With the aid of this Oscilloscope magneto timing, valve setting, and many other similar mechanical motions, can be tested.

A boiler load indicator, designed for indicating the load on a boiler at any moment, was shown by George Kent, Limited, of 199 to 201, High Holborn, W.C. 1. The firm's new coal meter, which has already been described in these columns, was also on view. Another of the firm's exhibits was a temperature control apparatus, designed to close down the supply of steam to a dye vat or other similar vessel, when the liquid in the vessel boils, but at the same time allowing sufficient steam to pass to keep the liquid on the point of boiling.

A new type of rotary synchroscope, for paralleling alternators and other synchronous machines, was shown by Nalder Bros. and Thompson, of 97A, Dalston-lane, E. 8. No moving coils are employed in these instruments, and slip ring and other troubles are, therefore, eliminated. Moreover, as the moving parts are extremely light, the power consumption is very small. A rotary synchroscope recently developed by the firm has a red, green and white signalling device which can be seen at a considerable distance, and a moving circular spot of light changes its colour from red to green or to white, according to the position of the pointer on the dial. Moreover, the coloured spot of light and the pointer are always in line with one another and, consequently, the the position of the light spot indicates the phase angle between the voltage of the incoming machine and that of the bus-bars. A red light is shown when the machine is out of phase, a green light when it is nearly in phase, and a white light at the correct moment for closing the switch.

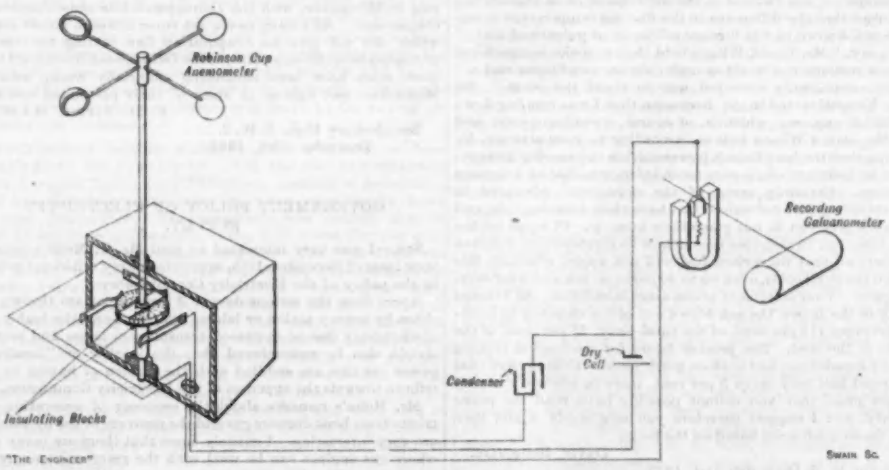



FIG. 5—THE CAMBRIDGE RECORDING ANEMOMETER

Siemens Bros. and Co., Limited, of Woolwich, were showing a four-colour temperature recorder, which gives four temperature records in different colours on the same continuous paper chart, and it may be used either with distance thermometers or thermo-couples. Another of this firm's exhibits was an optical pyrometer for measuring temperatures up to 2400 deg. Cent. The heated object is observed through a telescope, and its brightness is compared with that of a standardised electric lamp fitted inside the telescope. The temperature of the lamp varies with the current passed through it, and this current is measured by an ammeter and the corresponding temperature is read on a calibrated scale. A 40-way distance thermometer switchboard and indicator was shown in operation. The thermometers associated with this system of temperature measurement can be placed at any distance from the switchboard, to which they are connected by ordinary twin cable, and the temperature at any of the various points where the thermometers are placed can instantly be read on the indicator by depressing the corresponding lever switch.

The Marconi-McLachlan high-speed telegraph recorder, described in a paper some time ago by Dr. McLachlan, was exhibited by Marconi's Wireless Telegraph Company, Limited. The instrument, which is shown in Fig. 6, consists essentially of a drum of Swedish iron, with an annular recess containing coils of fine wire, the ends of the coils being connected to slip rings. The periphery of the drum is faced with cast iron rings, which are machined to run true within .000 1in. A small steel shoe rides on the rings, and side play is prevented by a guide piece with a projection which fits into the annular recess. At each end of the guide piece a hook is formed, and one of the hooks is connected by a light rod to a duralumin lever, which is pivoted to turn in a horizontal plane. A silver syphon from an inkwell overhead passes through the lever and rests lightly on a moving paper tape. To the other side of the lever a strong spring is attached, whilst the remaining hook is attached to a light spring, which prevents the shoe from rocking on the drum which is revolved by a small electric motor. When a current flows in one of the coils, the shoe is attracted to the drum and a large pull is required to prevent relative motion between the drum and the shoe. This pull is used to actuate

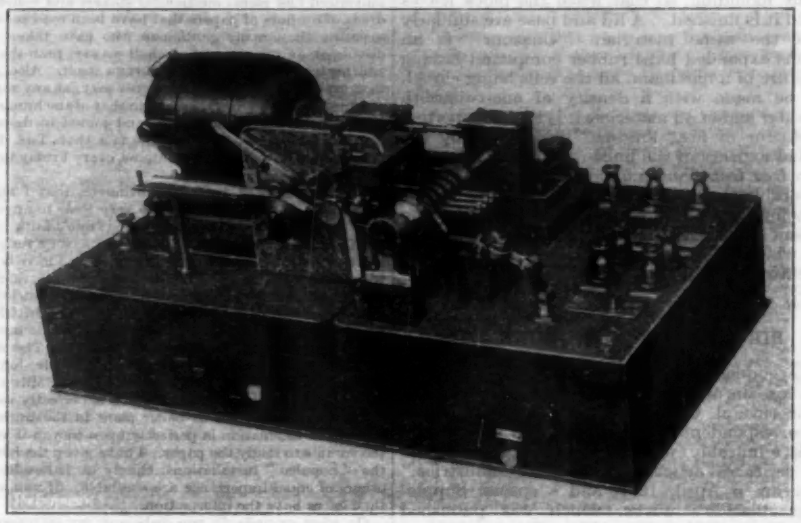


FIG. 6—THE MARCONI-McLACHLAN HIGH-SPEED TELEGRAPH RECORDER

the syphon lever mechanism, so that the transverse movement over the paper inscribes the incoming messages in the form of a series of rectangles, and the top part of these rectangles represents the dots and dashes of the Morse code. The tangential pull on the shoe is many times that calculated from the formula $\frac{B^2 A}{8 \pi}$, where $\pi$ is the coefficient of friction, B the flux density at the point of contact, and A the area of contact. The ratio of the actual to the calculated pull depends on the flux density, and has a maximum value of about 80 for steel or cast iron. Owing to this phenomenon, which gives amplification, and to the fact that there is no air gap in the magnetic circuit through the shoe, the instrument is extremely sensitive and will work at a speed of fifteen words per minute with a current of 25 micro-ampères. The instrument will work in a thermionic valve circuit, and for wireless purposes it is fitted with relay contacts, so that incoming messages in Morse may be directly relayed to a printing or other machine.

A very interesting pump for exhausting the bulbs of thermionic valves was exhibited by the Mullard Radio Valve Company, of Balham. The pump is known as the Holweck Molecular pump. The stator of the pump is provided with two inlet tubes, one of which is connected to the vessel to be evacuated, the other being connected to a backing pump usually of the "box" variety. The rotor shaft carries a standard form of "squirrel cage" rotor, such as is used on small induction motors. The motor drive stator is bolted to the end flange of the pump, and the windings of this stator are fed with two-phase alternating current. This is supplied by a small rotary converter driven from 110-volt direct-current mains. The normal running speed of the rotor is 4500 revolutions per minute. All rotating parts are on ball-bearings, the clearance between the pump rotor and stator being 1.5 thousandths of an inch. The molecules of gas from the vessel undergoing evacuation enter a canal, one side of which—the drum or rotor—is rapidly moving, the other boundaries of the canal being formed by a groove cut in the walls of the stator. By successive impacts on this rapidly moving wall—the drum or rotor—the molecules are given a general impetus in one direction, and are finally removed by the backing pump. It is essential to the operation of a pump of this kind that the mean free path of the molecules be great in comparison with the transverse dimensions of the canal. The advantages claimed for the pump are small dimensions; easy erection; low upkeep costs; absence of oil in the pump; noiseless drive, and high vacuum attainable without the use of a freezing trap for volatile vapours.

The Record Electrical Company, of Manchester, was showing a complete range of moving coil permanent magnet, switchboard and portable ammeters and voltmeters. In these instruments the pointer deflects through an arc of approximately 300 deg., this deflection being obtained entirely without gearing, whi'e the length of the scale is more than

twice that of any bi-polar instrument of equivalent dial diameter. The patented type of flat circular pole shoe interleaved between two plates of opposite polarity form two air gaps which are geometrically and magnetically in parallel, and an astatic magnetic system produces a strong working field, and remarkable freedom from external magnetic interferences.

A new block calorimeter, designed by Professor Boys, was exhibited by John J. Griffin and Sons, Limited, of Kemble-street, Kingsway, London, W.C. 2. This is the latest development of the small "spot test" calorimeter derived from Professor Boys' recording calorimeter. In this instrument the whole of the metallic water-containing structure of the calorimeter is replaced by a single block of "Onazote" with all the water passages and spaces formed by moulding, so that when the block leaves the mould it is finished. A lid and base are similarly made of the same material. "Onazote" is an impervious expanded hard rubber compound having the structure of a fine foam, all the cells being closed. It may be made with a density of one-twentieth that of water and of all materials it is the most perfect non-conductor of heat known. Besides saving the weight and expense of the built-up metallic structure it is also free from longitudinal heat conductivity—an undesirable feature of metallic calorimeter vessels—and, being impervious to water, the risk of being wetted and thus losing much of its heat insulating quality, which follows from the use of other insulation, is entirely avoided.

## SIR EDWARD CAPEL-CURE.

By the sudden death of Sir Edward Capel-Cure we have lost an old and valued friend. Sir Edward acted for several years preceding the war as the Italian correspondent of this paper, and that he did his work admirably will be admitted by all who recall a series of articles on "Italian Industries" which began in April, 1906, and a special Supplement on Ansaldo's works, which was published with our issue of May 8th, 1914. He was not an engineer, and used himself to admit, jocularly, that his only practical knowledge of engineering was gained by painful experience with a steam launch which he ran on lake Maggiore. He had, however, a deep sympathy with engineering, and being an experienced writer was able to acquire and transmit information which he gleaned from others. One of the ardent desires of his life was the establishment of a closer understanding between the British and Italian peoples, and he was tireless in his efforts to secure it. On the occasion of the intended visit of the Iron and Steel Institute to Italy in 1911, he devoted a great deal of his time to the arrangement of the programme and prepared a series of articles on the "Iron and Steel Industries of Italy," which ran in our columns at the time. His disappointment when the visit was abandoned, for reasons which he considered insufficient, was rendered more acute by the hopes that he had based on the outcome of the visit and by the intimate personal knowledge he had of the steps which had been taken by the ironmasters of Italy to show their visitors unexampled hospitality.

Sir Edward was the eldest son of the Rev. Edward Capel-Cure, Canon of Windsor and Chaplain-in-Ordinary to Queen Victoria. On leaving Winchester he entered New College, Oxford, and took honours in History. His subsequent career was an interesting and varied one. Making his home in Italy, he gave much attention to literature and to art, and practised for a time as a journalist and art critic in the Italian papers. His devotion to the best literature of his own and his adopted country was profound. Early in the war he was appointed Commercial Attaché at the Embassy at Rome, and in 1918 he was appointed Commercial Counsellor of the Embassy for Italy. He threw himself into this work with the nervous energy which characterised him, and for his services he was rewarded in 1919 with the honour of knighthood.

A man of charming personality, a large knowledge of men, and an infectious passion for work, he leaves behind him in Italy a host of friends who regarded him as one of themselves — was he not a Commendatore ?—and in this country many who, without personal knowledge, pay respect to his ideals and honour him for the work he achieved.

## THE INSTITUTION OF CIVIL ENGINEERS.

MAKING the public announcement that as the result of the grant of a third supplemental charter its members and associate members are now entitled to call themselves chartered civil engineers, the Institution of Civil Engineers says :—Whilst the unregulated and unrestricted use of the appellation "Civil Engineer" has deprived it of all weight and significance in the matter of professional qualifications, the designation of Corporate Membership of the Institution ("M. Inst. C.E." or "Assoc. M. Inst. C.E.") has come to be recognised as an authoritative mark of professional competence and standing. Nevertheless, the mere designation of membership of a society has been found in recent years scarcely to carry with it that definite idea of status to which the public is accustomed in dealing with professional men ; hence the adoption of the term now authorised to the members of the Institution, namely, "Chartered Civil Engineer."

# Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### POWDERED FUEL.

SIR,—In view of the truly amazing statements you have made in your editorial of the 28th inst., under the above title, concerning my paper "Pulverised Fuel and Efficient Steam Generation," I must ask you to allow me to occupy some space in your correspondence columns and to print this letter as you receive it. I have no objection to criticism, but, in the first place, I am not going to enter into a competition with you in the writing of offensive insinuations. I will merely content myself at the moment with stating that I am less interested in the sale of pulverised fuel plant, mechanical stokers and boilers than hundreds of authors of papers that have been read before scientific societies, than many gentlemen who have taken part in the discussion on my paper, and, shall we say, than the advertising and business staff of THE ENGINEER itself. Also I may state that my object in reading the paper may, at any rate, be safely assumed to be on an equal plane to that of the hundreds of other authors who have read papers and joined in discussions condemning pulverised fuel, and the fact that THE ENGINEER is published, with advertising columns, every Friday for 1s., that is, the good of the human race.

You state, or, at any rate, insinuate, that I am no longer impartial. It will at any rate be very clear to anyone who has read my paper and your editorial that one's faith in the impartiality of THE ENGINEER has received a very rude shock, and for the following reasons. You remark that I have been "primed with American 'facts.' We do not know whether these facts may be taken without reserve or if the observations are absolutely comparable with those made by the British method of measuring boiler efficiencies and outputs." I do not understand exactly what is underlying this statement. The facts are the continuous performance figures obtained by Mr. John Anderson, the chief engineer of the Lakeside Station, Milwaukee, which anyone is allowed to visit and which is perfectly well known to possess the most efficient boiler plant in the world. Also the method of calculation is perfectly open to you if you will take the trouble to study the paper. I have given the facts regarding the "Lopulco" installations, chiefly at Lakeside, because no others of equal importance are available. If you know of any, then let us have the information.

On what grounds do you disbelieve my statements, those of Mr. John Anderson, or the word of Mr. W. R. Wood, the Ford Motor Company, and Messrs. Maclellan and Junkersfeld, of New York, and apparently take implicitly the word of Sir John Kemnal, Mr. O. W. Partridge, Mr. David Wilson, and Mr. Pochobradski ? The belief in your own impartiality must on this account alone have received a somewhat rude shock in the minds of any unprejudiced engineer, who perhaps also has horrid doubts in his mind that many of the gentlemen so bitterly and virtuously opposed to my paper may just possibly be themselves interested in mechanical stokers and unit pulverisers for which already orders have been lost in three years equal to nearly 2,000,000 square feet of heating surface.

With regard to Mr. Pochobradski, this gentleman got up in the discussion and read out from sheets of paper a string of figures apparently to prove, mathematically and theoretically, that the Lakeside Station at 85–86 per cent. efficiency, as already stated, the most efficient in the world, with less wear and tear, maintenance, labour, and auxiliary power costs, is really inferior to Dalmarnock at 76½ per cent. efficiency, and was not to be compared with some unit pulveriser boiler plant, presumably not yet in existence. I have not so far received a copy of Mr. Pochobradski's figures, and I could not understand half he said ; but I suggest this gentleman, in spite of your agreement with him, is talking nonsense. One would have thought, for example, it was obvious to the intelligence of an engineering apprentice that the difference in the flue gas temperature is due to the well-known higher furnace efficiency of pulverised coal.

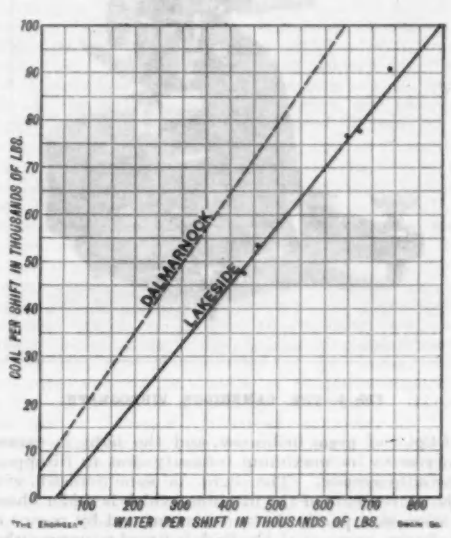
You say, "Mr. David Wilson held that to make comparisons between stations not working under similar conditions and not equally scientifically operated was to cloud the issue." Sir James Kemnal stated in the discussion that I was running down the British engineer, which is, of course, quite incorrect ; and then Mr. David Wilson follows, according to your account, by inferring that the best British power station engineering as represented by Dalmarnock, is very much inferior to that of American engineers. Certainly some of the arguments advanced in desperation against pulverised fuel have their amusing side, and it seems a pity you do not grasp their humour. Of equal calibre is the idea that British coal is somehow so mysteriously different to American that pulverised fuel will not apply, although this method burns all coals, even up to 40 per cent. ash and 5 per cent. of sulphur. Your statement about ashes is childish. As I stated clearly in the paper, the ash blown out of the chimney in Lakeside averages 17½ per cent. of the total—say, 2½ per cent. of the weight of the coal. The present figure for mechanical stoking actually equals this, and is often much more. Your remark that pulverised fuel only saves 5 per cent. more in efficiency is only another proof that you cannot possibly have read the paper properly, and I suggest therefore you now study it and then write another editorial based on the facts.

DAVID BROWNLIE.

London, W. 5, December 31st, 1923.

[If Mr. Brownlie is amazed by our leading article on his paper, we are certainly no less amazed by his letter. We are, in the first place, wholly at a loss to understand his reference to "offensive insinuations." We believed that Mr. Brownlie was interested in the sale of pulverised fuel plant ; if he is not, the mere statement of that fact would be both more convincing and more courteous than the charge he levels against us. There would be nothing whatever derogatory in such a connection, as we took pains to point out. The "Electricals'" habit of allowing full debates between interested parties is not without its merits. We are sure that Sir James Kemnal and Mr. David Wilson will not charge us with making "offensive insinuations" against them if we say they are "interested" in mechanical stokers. With regard to the sentence quoted in his second paragraph, we must refer him for an explanation to the context in the "leader." He asks us why we disbelieve his words and those of others. We expressed no such strong opinion as disbelief. We expressed some doubt, based on the character of the discussion, that American and British figures are strictly comparable, and we said explicitly—which Mr. Brownlie appears to have overlooked —"If a desire for strict truth obliges us to look cautiously upon American claims for a powdered fuel system advanced for business purposes, in equal measure it requires us to weigh well the criticism of people who are interested in mechanical stokers. We have to steer an even course between these conflicting elements." Since Mr. Brownlie likes to find humour in criticism, we are a little chagrined that the sportive nature of our reference to ash disposal escaped him. As for the rest of Mr. Brownlie's letter, we leave it to the gentlemen who share the assault upon us. With regard to the "5 per cent.," it was simply a rhetorical figure. Mr. Brownlie may make it what he pleases. The point that we desired to make is that in power stations it is the overall economy rather than the thermal efficiency of the boilers that must be considered.—ED. THE E.]

SIR,—You did excellent service, in the interests both of scientific discussion and of unimpeachable data, by your leading article last week. In support of your views, may I call attention to the tabulated statement of five boiler tests at Milwaukee given in the paper referred to. The absurd degree of accuracy claimed for the results is shown by the facts that the duration of each test is given to the hundredth of an hour, while coal and water consumption figures, ranging to upwards of two million pounds, are solemnly set down to the last pound. In spite of this extreme precision of testing I find very good reasons for disregarding altogether the results claimed. If you plot the coal consumption of any power station per eight-hour shift against the water consumption for the same period, on the Parsons' method, you get a straight line. The line for Dalmarnock is represented by the equation $C = 5123 + 0.1487\ W$, which shows that the boilers requires 5123 lb. of coal per shift to




make up radiation, &c., losses. Now, as a great point of the paper to which you refer is to draw a comparison between Dalmarnock and Milwaukee stations, I have treated the Milwaukee figures in a similar way. Any one doing this will find that the evaporation line for Lakeside is very closely represented by the equation $C = 0.1250\ W - 5000$. This, of course, is utterly absurd, as it indicates that the heat losses at Milwaukee are negative, and that the boilers would evaporate 40,000 lb. of water per shift with no coal at all ! I enclose the diagram referring to Milwaukee, with the Dalmarnock line shown dotted for comparison. As I have never yet come across a power station which did not give an evaporation line cutting the vertical ordinate above the zero point, as the Dalmarnock line does, I think there must have been something materially wrong with the Milwaukee test figures, in spite of their pretended accuracy.

F. D. NAPIER, M.I.E.E.

Brondesbury Park, N.W. 2.
December 29th, 1923.

### GOVERNMENT POLICY OF ELECTRICITY SUPPLY.

SIR,—I was very interested to read Mr. T. Mohn's letter in your issue of December 17th, approving of my criticisms relating to the policy of the Electricity Commissioners.

Apart from the serious danger if large areas are thrown into chaos by enemy action or labour difficulty, and the higher cost of electricity due to increased transmission losses and costs, it should also be remembered that the smaller or "localised" power stations are saddled with the burden of having to contribute towards the expenses of the Electricity Commission.

Mr. Mohn's remarks about the economy of generating electricity from blast-furnace gas and the recovery of the by-products are very interesting. I entirely agree that there are many cases where gas engines can be used with the greatest economy and advantage. The Diesel engine for power stations has, however, the advantage of greater simplicity, as there are no producers, and stand-by losses are eliminated, as the engine can be started immediately when required. A sufficient quantity of fuel oil can be easily stored in a small space to operate the plant for a long period.

I would like to remind Mr. Mohn that during the war practically every Diesel engine in this country used home-produced tar oil as fuel, so that if the greater use of gas engines would, amongst other by-products, produce a cheap supply of tar oil, the combined use of Diesel and gas engines would offer a further economical aspect for cheaper electricity.

I endorse Mr. Mohn's remark that there should be more co-operation between the public and the Electricity Commissioners, but I fail to see how this is possible when the policy of the Commissioners is wholly towards the granting of monopolies to large areas. The only redress that a "localised" power station has is an expensive suit if it chooses to contest their findings. At present there are several such pending.

H. T. DAY.

7, Grosvenor-gardens, S.W. 1, January 2nd.

## Railway Matters.

ON Thursday, the 20th ultimo, a special train with passengers and mails off the George Washington ran by the Great Western route from Plymouth to Paddington, 226 miles, without a stop in 234 min.

THE late Sir Joseph H. Kaye, of Huddersfield, was a director of the Lancashire and Yorkshire Railway, who joined the board of the London and North-Western on its amalgamation two years ago and became one of the original directors of the London, Midland and Scottish Railway Company on its formation.

AN agreement has been reached between the Irish railway companies and the railway unions regarding the establishment of machinery for the future regulation of trade disputes. The principal body will be a Wages Council consisting of seven representatives of the companies and a like number from the trade unions, while sectional councils for the regulation of other matters will be established.

THE accommodation at Machynlleth on the Cambrian section of the Great Western Railway is to be improved. Whilst Dovey Junction Station is the actual exchange point for the Aberystwyth and Barmouth directions, all trains do not stop there, and so most of the passengers change at Machynlleth. The platform is to be lengthened by 150ft., additional sidings are to be provided, and the connections leading to and from the engine shed and the accommodation for engines are to be improved.

IT has been decided to construct a second tunnel through the Vosges at the same time as the tunnel which is to be constructed for the line from Saint-Die to Sainte-Marie-aux-Mines. The second tunnel will be cut to link up Cornimont and Metzeral. The railway line will pass through the Moselotte Valley, serving La Brasse, and will then run through a tunnel of 1800 m., coming out into the Thur Valley, with a station at Wildenstein. A second tunnel will link up the Thur and Fecht Valleys and will lead to Metzeral. The total distance covered will be about 23 kiloms.

INCLUDED in the list of New Year Honours is the name of Mr. Arthur Watson, the general manager of the London, Midland and Scottish Railway, who receives a knighthood. In the Indian List is a knighthood for Mr. J. E. Jackson, the chief auditor and accountant and acting agent of the Bombay, Baroda and Central India Railway, and the Order of Commander of the Indian Empire for Mr. E. W. P. Sims, manager and engineer-in-chief of the Junagadh Railway, and Mr. George Deuchars, the late Government Director of Indian Railway Companies at the India Office.

IN *The Times* of Friday last was the complaint of a correspondent that his son booked at Charing Cross to Redhill and then found that there was no train. The lad consequently went to London Bridge to go to Redhill by the Brighton route. His ticket was not honoured there and he had to pay a fresh fare. An explanation from the railway company was attached to the complaint, which said that this was quite in order, but that the money for the first ticket would be refunded on application. It was further observed that there was a tremendous amount of detail involved in the amalgamation, but that in the course of time all such anomalies will disappear.

THE correspondence in *The Times* in which Lord Montagu and Sir Herbert Walker have taken part, as to the London—Liverpool motor way, received added interest in the issue of the 31st ultimo, by a letter from Sir William Acworth, who pointed out that under the Railways Act the Railway Rates Tribunal shall allow the companies to charge such rates as will yield them their pre-war net revenue. If, then, the companies lose their present profit on the carriage of high-class commodities in the district lying along the new motor way route the rates on other traffic—the coal which motors will hardly touch, the passenger and freight in districts outside the area of the new competition—will have to be put up to redress the balance.

Two serious railway accidents have occurred on New Year's Day. On January 1st, 1885, the axle of a privately owned wagon broke near Penistone, causing a derailment and into the train a passenger train ran, causing the death of four passengers. This accident was noteworthy, in that it led to requirements being laid down for the construction of privately owned wagons. The year 1915 was the worst, in the matter of accidents, experienced by British railways. It opened with ten passengers being killed in a collision at Ilford, owing to the driver of one train overrunning the signals. The only fatal accident to a passenger train in the year 1918 was on January 3rd. It occurred at Queensferry Junction, Ratho, and was due to the signalman assuming that the driver of a light engine would remain where he was were he not told to move, whilst the driver thought that as he had not been told to stand the line was clear. The light engine moved ahead and fouled the path of an express, causing the death of twelve passengers.

THE programme of new works and details of the locomotives, rolling stock and rails contemplated by the London, Midland and Scottish Railway and the London and North-Eastern Railway has now been followed by similar details as to the intentions of the Great Western. Orders have been placed for 32,000 tons of rails, 20,000 tons of chairs, 5,000 tons of tires and wheel centres to the value of £46,000, and 50 locomotive boilers. In addition to the work in the company's own shops, from 300 to 500 20-ton mineral wagons are shortly to be requisitioned. Tenders have been invited for the provision of 18 new coal tips at the docks in South Wales, involving an expenditure of £475,000. In addition to the second tunnel at Colwell and the widening between Welshpool and Forden, already mentioned in this column, the completion of the Cwmgorse Railway, as between Felin Fran and Pontardawe, is to be put in hand. Improved stations are to be built at Newport, Mon., and Swansea, High-street, at a cost of £497,000 and £264,000 respectively, whilst Temple Meads goods station, Bristol, is to be reconstructed at a cost of £556,450. Reference has already been made herein to the building of the stations at Newton Abbot and Aberystwyth.

## Notes and Memoranda.

THE Cameron Falls Development in Ontario will ultimately exceed 100,000 horse-power, and with the diversion of the rivers flowing north, there will be built up a capacity of 300,000 horse-power or more.

SOME indication of the extent of electric power development in Canada is given by the fact that the daily output of a single new factory in Quebec will amount to 5000 top pins or brackets for transmission lines, 500 cross arms and a large amount of miscellaneous products.

THE by-product plant at the Newcastle, Australia, steel works of the Broken Hill Company is capable of an output of 1,500,000 gallons of benzol a year. The plant is designed to produce commercially pure benzol, toluol and xylol, if required; but the benzol and toluol are being marketed together as motor spirit.

ACCORDING to Mr. E. A. Bolton, of the Metallurgical Department of Birmingham University, the most important cause of red stains on brass lies in the use of old-fashioned furnaces in which the flames have direct access to the metal. Red staining is seldom present before the pickling operation; it is formed as the result of reactions between the copper oxides in the scale and the pickling acid.

SOME valuable areas of unworked coal exist, according to Mr. W. B. Wright, in the counties of Antrim and Tyrone. The margin of one of the coalfields indicated is visible at Coalisland, Co. Tyrone, where the newer rocks have been removed by denudation, and is now being worked some little distance in from the outcrop. An exceptionally rich series of coals has been penetrated and a large output is confidently predicted.

THE annual memorandum by Mr. C. E. Stromeyer, chief engineer to the Manchester Steam Users' Association, covering the year 1922, contains several interesting matters. Tests have been made on the material of some old wrought iron boilers, one of which was sixty-nine years old, and a comparison with the tests of the original material shows that wrought iron does not lose tenacity appreciably with age. The furnace plates show a reduction of ductility, but not of tenacity.

A NOVEL form of tank for storing volatile spirits is described in the *Engineering News-Record*. The spirit is of such a low boiling point that it is necessary to keep it under pressure, at atmospheric temperature, or it will evaporate. The tanks are made globular in form, the better to withstand the internal pressure, and some of them are as large as 48ft. in diameter, while their capacity is up to 420,000 gallons. The working pressure is from 15 lb. to 20 lb. per square inch.

THE preliminary report of the Bureau of Statistics places Canada's total mineral production, covering both metallics and non-metallics, for the year at 214,102,000 dollars, which is an increase of 30,000,000 dollars, or 12 per cent., over the previous year. The volume of the total production was the highest in the history of the Dominion. The copper production is valued at 12,515,000 dollars, and the tonnage has been doubled as compared with last year. The nickel production is valued at 18,433,000 dollars and shows an increase of 350 per cent in quantity. The gold production totalled 24,382,000 dollars, which is a decrease of 1,734,000 dollars as compared with last year. The silver production is valued at nearly 11,000,000 dollars, which is a decrease of 1,500,000 dollars.

THE American practice of lining mine shafts with concrete does not appear-to be altogether satisfactory as a large number of the downcast shafts which are lined with concrete are pock-marked. The lining is scaling and disintegrating. Moisture or rain or dripping shaft water is sucked down with the incoming air, and, of course, wets the surface of the lining. The concrete naturally absorbs some water, and alternation of freezing and thawing eats into the lining, causing it to scale. Of course, in constructing a plain concrete lining it is possible, with very careful puddling while the concrete is being placed, to remove most of the small air bubbles, and in some linings waterproofing compounds have been used, but the success of these waterproofings has been rather indifferent. This trouble with linings to-day is the most serious problem in good shaft construction.

OF all known deposits of nickel ore the Sudbury deposits in Canada are by far the most important. At the end of 1916 it was stated that the ore which might ultimately be obtained from them would probably exceed 150 million tons, which would be sufficient to maintain the normal annual output for a century. Other known deposits of nickel ore within the Empire are in Tasmania, South Africa, India and Egypt. So far as they have been explored, they appear to be comparatively small, and as sources of supply of nickel ore are not likey to be seriously exploited so long as the large Sudbury deposits are available. Nevertheless, they constitute a useful mineral asset. Of nickel deposits in foreign countries those of New Caledonia are second in importance in the world to those of Sudbury. For some years past Norway has produced appreciable quantities of nickel from native ores, but so far as is known the ore reserves are not large. A considerable tonnage of low-grade ore is mined in Germany.

A BOOKLET just issued by the American Bureau of Chemistry deals with the explosion of aluminium powder and gives some hints on the quelling of resulting fires, which, it is said, are difficult to extinguish, owing to the reducing action of the hot aluminium on most substances used in the ordinary chemical extinguisher and to the chemical action between powdered aluminium and water. When sodium carbonate was applied to red hot aluminium an explosion usually resulted. It was found that red hot aluminium would reduce the carbon dioxide of the carbonate and that it would also reduce gaseous carbon dioxide. Some experiments were conducted in the use of Foamite-Firefoam for extinguishing aluminium dust fires. These experiments were wholly unsuccessful, since both the water and the carbon dioxide were as fuel to the fire. Ordinary sodium chloride proved to be a most satisfactory material for use in extinguishing aluminium dust fires. If poured on a pile of red hot aluminium it melts on the surface and forms a thick crust which soon extinguishes the blaze.

## Miscellanea.

IT is hoped to complete the Gampola Bridge in Ceylon in about eighteen months' time.

THE rate of output of the iron mines at Ouenza, North Africa, is now over 40,000 tons a month.

THE St. Arnaud Borough Council, Victoria, has decided to instal electric light and power in St. Arnaud, at a cost of about £14,500.

THE Johannesburg Town Council is contemplating the expenditure of £1,000,000 on the construction of a power station at Witbank.

THE output of the coal mines of Great Britain for the week ending on December 22nd was 5,886,000 tons, as compared with 5,956,000 tons for the previous week.

IT is reported that a company has been formed in Brazil for the purpose of erecting blast-furnaces at Sao Joao do Morro Grande and at Santa Barbara for producing foundry pig iron.

LARGE copper ore deposits are reported to have been discovered in the commune of Krivelj—Department of Timok, Yugo-Slavia—in the vicinity of the well-known Bor mines.

TENTATIVE proposals for the development of the St. Lawrence River, Canada, provide for the construction of a dam to cost 75,000,000 dollars, with a maximum capacity of 750,000 horse-power.

DAMAGE to a dam at the New Brunswick Electric Power Commission's development on the west branch of the Musquash River has been repaired and the power plant is in operation once more.

DRILLING is to be undertaken in Canada to ascertain the possible extent of the iron ore deposits that occur on the north shore of Lake Athabasca, 60 miles east of the Hudson Bay Company's post at Fond du Lac.

THE assistant director of the Federation of British Industries, Mr. G. H. Locock, has now returned from his tour in South America, and his report on the markets visited will shortly be ready for distribution.

THE contract has been awarded for the construction of a tunnel, 6 miles long, through the Continental Divide, between Canada and the United States, for shortening the route between Denver and the Fraser River.

THE discovery of another big copper deposit, at N'Changa, Rhodesia, is reported in the *S.A. Mining and Engineering Journal*. The ore is principally carbonate, and contains from 3.2 up to 17.4 per cent. copper.

IT is reported that contracts amounting to £765,000 have been placed by the Underground Company for 85,000 tons of cast iron tunnel segments. These are to be used for enlarging tunnels on the City and South London line and for the new extension line between Charing Cross (Hampstead line) and Kennington, *viâ* Waterloo.

THE latest standard specification issued by the British Engineering Standards Association deals with the electrical performance of traction motors of the series-wound, direct-current type. This specification keeps closely in line with the rules for traction motors of the American Institute of Electrical Engineers. Copies may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1.

TENDERS are to be invited immediately for the power-house plant of the Arapuni hydro-electric power scheme, in New Zealand, the specifications for which have been issued by the Public Works Department. Tenders have already been invited for the first section of the head-works, comprising the diversion tunnel, main dam, &c., and are returnable by February 28th, 1924. The plant is to comprise three units of 25,000 horse-power each.

A COMPANY formed by the principal copper-producing companies in Australia—in conjunction with a British company—has considerably augmented its works at Port Kembla, New South Wales, which are now capable of handling more than the Commonwealth's requirements of copper wire, rods, bars, strips, cables, &c., copper and brass tubes and pipes, and aluminium steel-cored cable. The company is now manufacturing covered telephone cables.

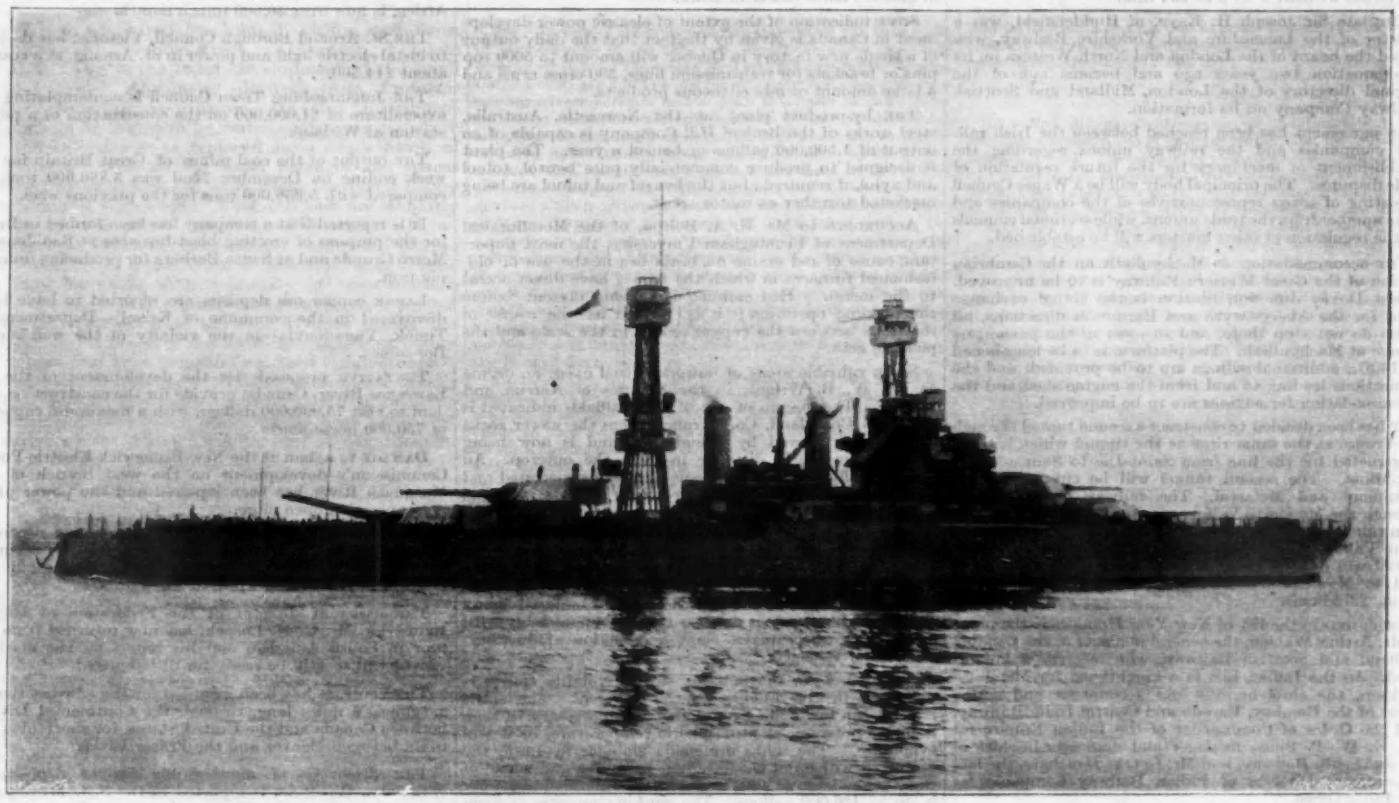
IT appears that the conditions of the steel rolling mills in Canada are improving, as the British Empire Steel Corporation at Sydney, N.S., reports that orders now on hand and pending will mean full time operation up to June, 1924. During 1922 pig iron production at Sydney was 120,769 gross tons. For 1923 the amount is put at 285,000 gross tons, an increase of about 136 per cent., while the output of steel ingots increased from 139,021 tons to 306,000 tons.

IT is proposed, says the *Iron and Coal Trades' Review*, to organise a selling agency for the heavy steel trade, particularly for export. This, of course, has been before the trade for many months, and has received a considerable amount of support from members of the National Federation of Iron and Steel Manufacturers. Desirable as the project would be in many ways, there are, however, many difficulties to be surmounted before such a proposa could be brought to fruition.

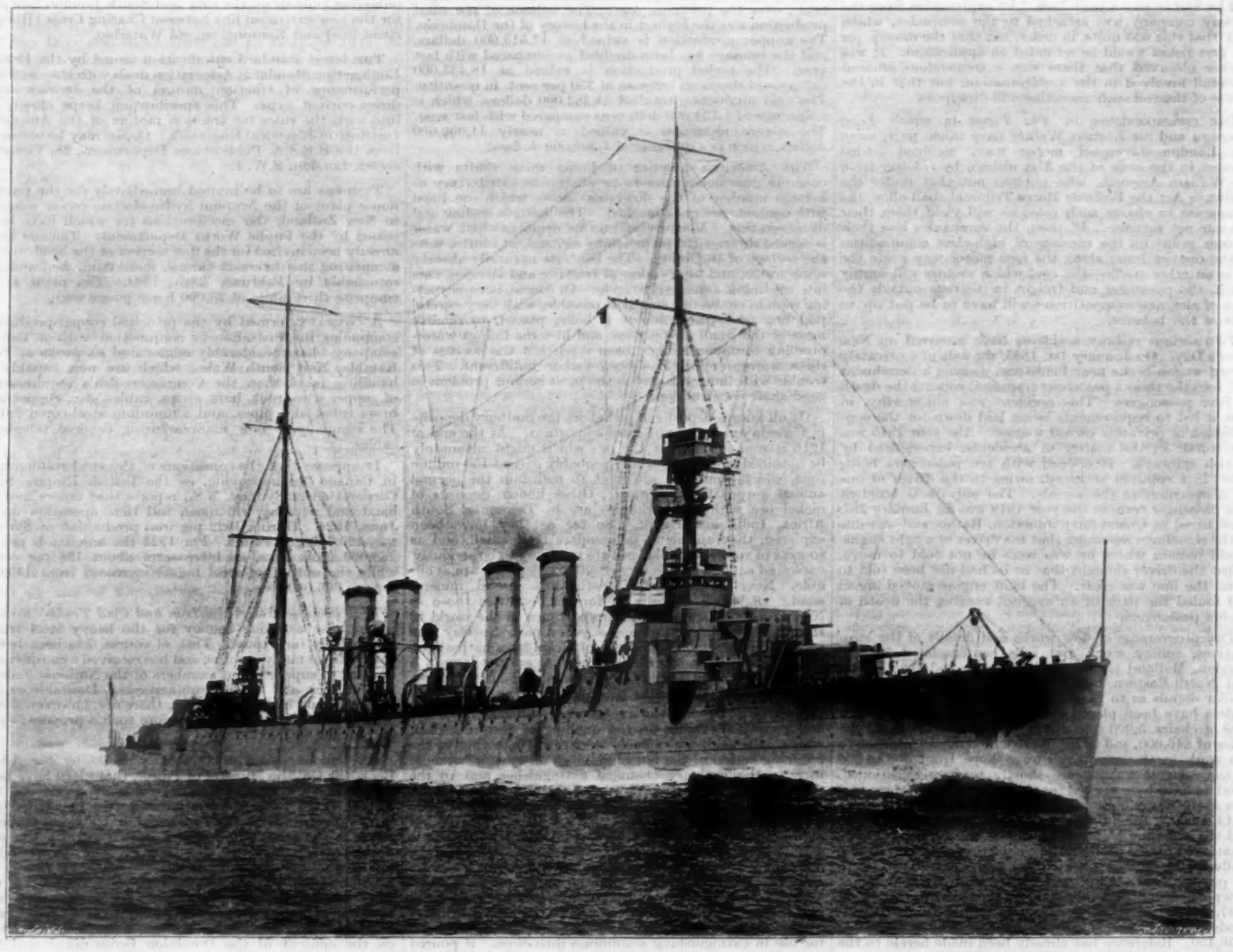
AN announcement was recently made by Sir Adam Beck, the Ontario Minister of Power, that plans have been prepared for a large power development scheme on the St. Lawrence River, near Morrisburg, to be carried out in co-operation with the Provincial and Federal Governments. The scheme proposes a dam, control works and development which will cost from seventy-five to eighty million dollars, and will provide 350,000 horse-power for use in Ontario. The power dam will raise the level of the water in Toronto Harbour by 2ft. and in Montreal Harbour by 1½ft. The development will take five or six years to complete. The carrying out of the scheme is dependent on the consent of the Dominion Government and the co-operation of the United States Government either as a Government or through a private company.

# TWO UNITED STATES WARSHIPS OF 1923

(For description see page 3)

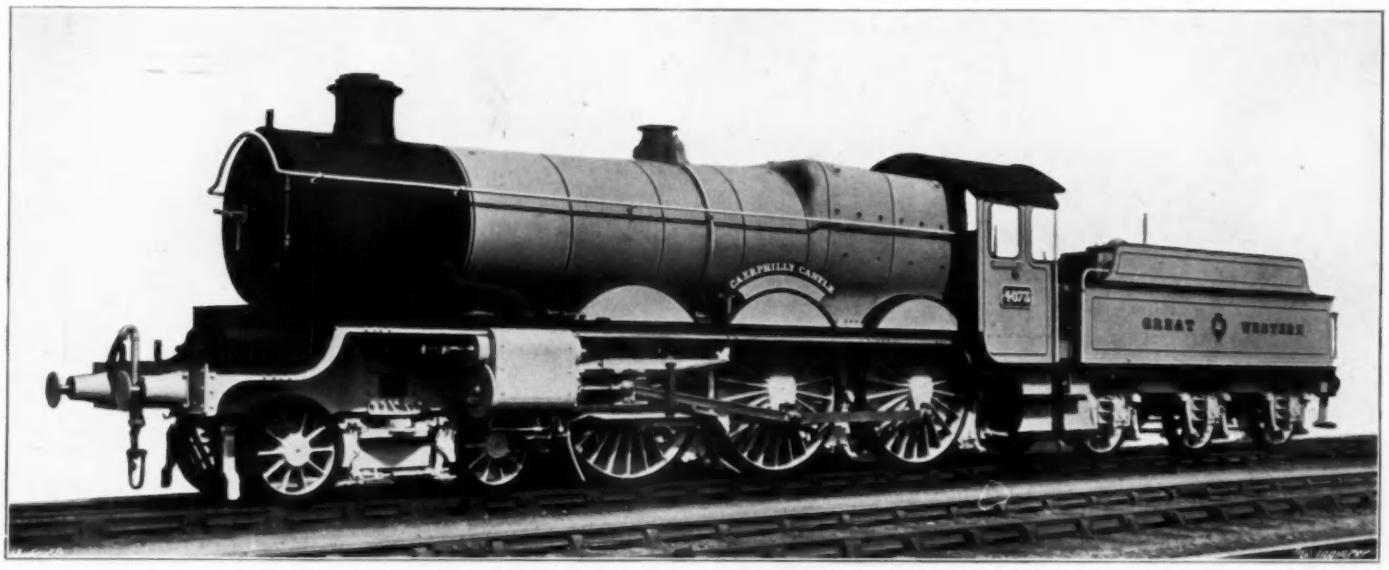


THE BATTLESHIP COLORADO

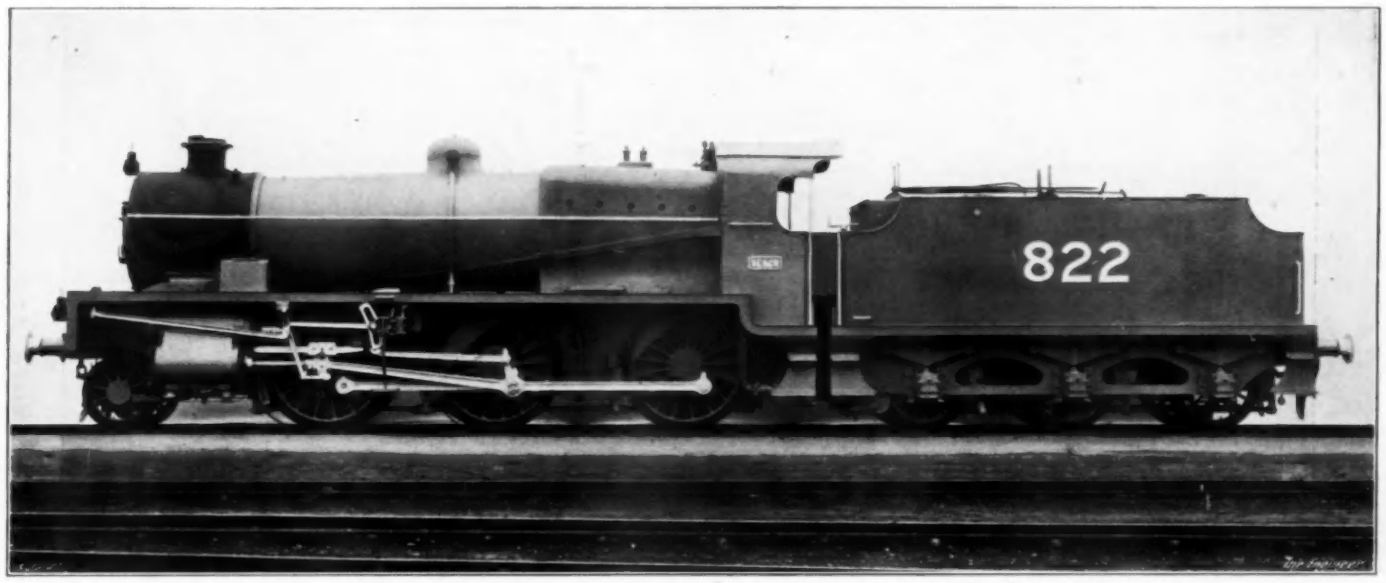


THE LIGHT CRUISER DETROIT

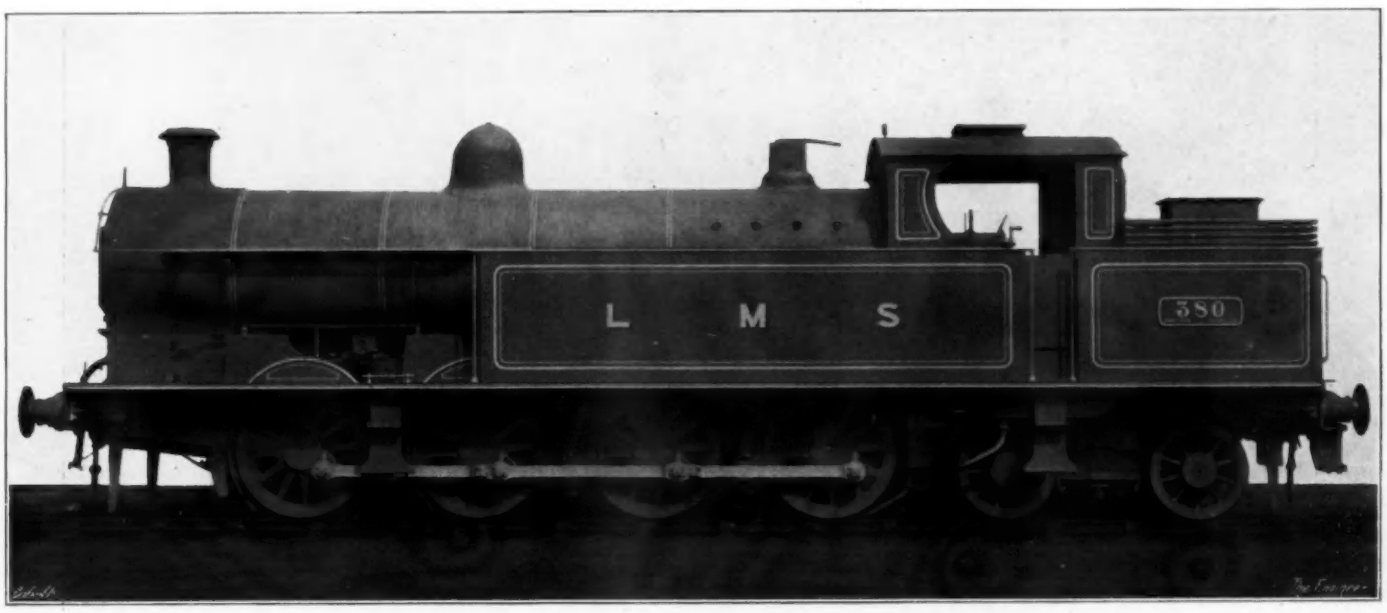
# SOME BRITISH LOCOMOTIVES OF 1923




GREAT WESTERN RAILWAY—SIX-COUPLED FOUR-CYLINDER SUPERHEATER ENGINE

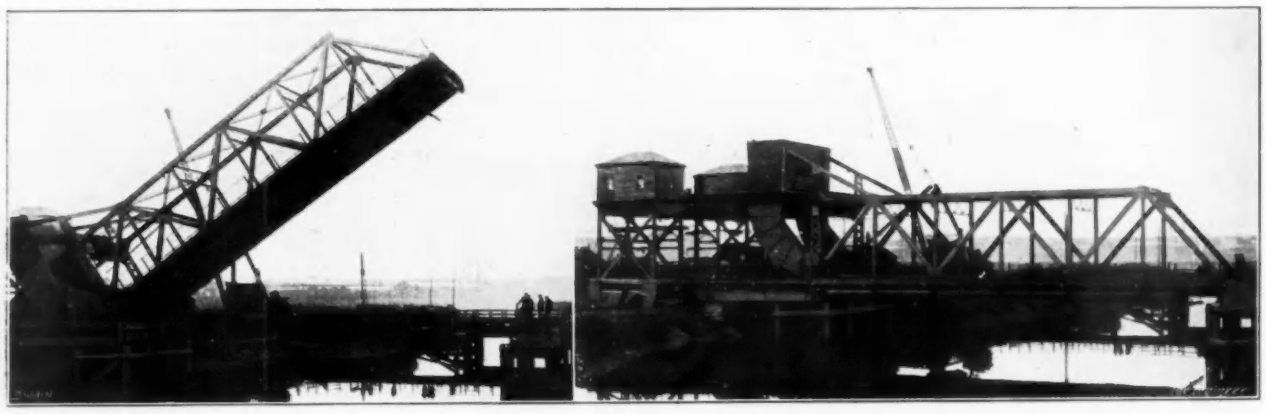



SOUTHERN RAILWAY—THREE-CYLINDER SUPERHEATER ENGINE




LONDON, MIDLAND AND SCOTTISH RAILWAY—EIGHT-COUPLED TANK ENGINE

# CIVIL ENGINEERING IN 1923

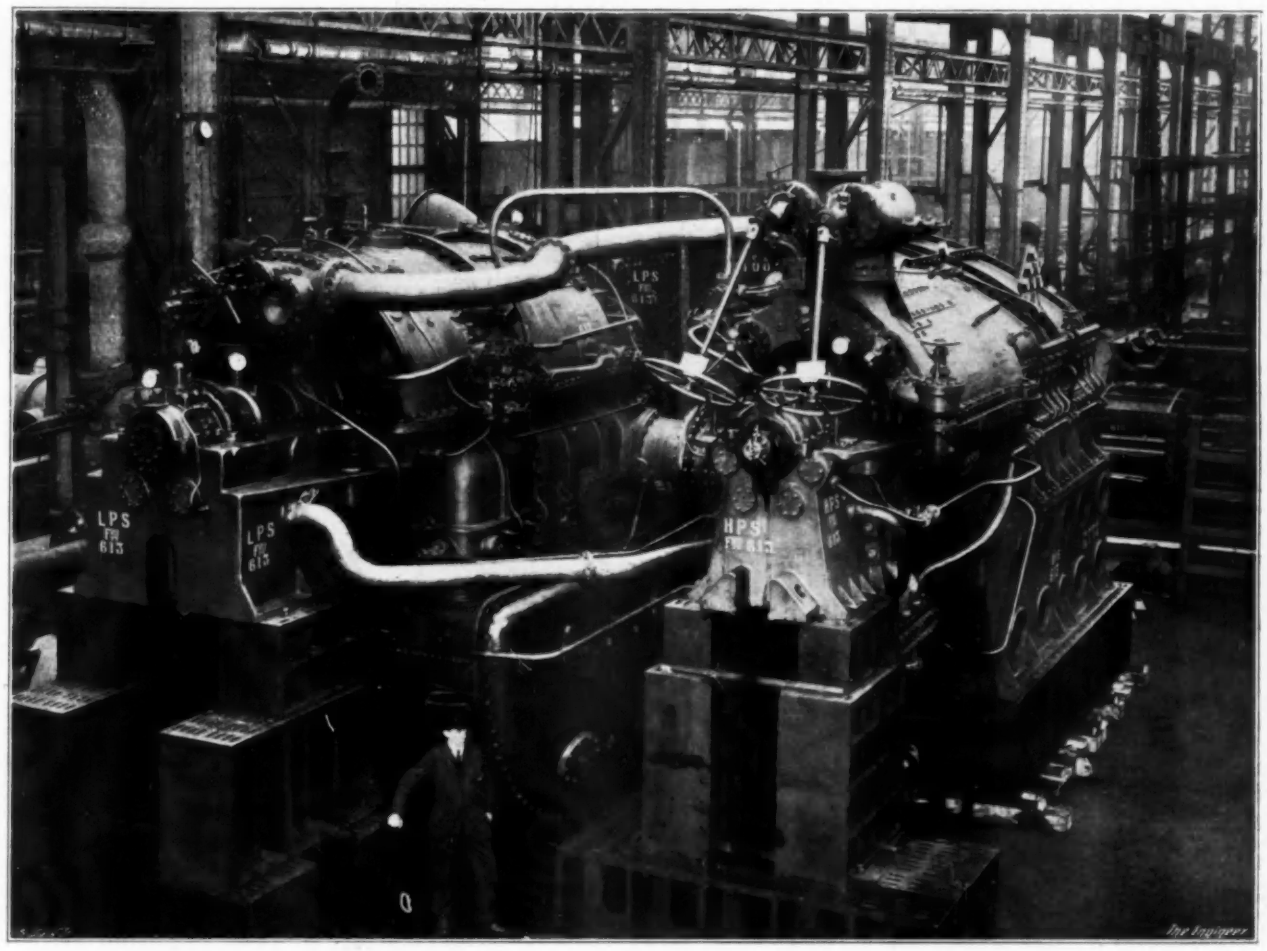


ROLLING-LIFT BRIDGE AT INCHINNAN, RENFREW

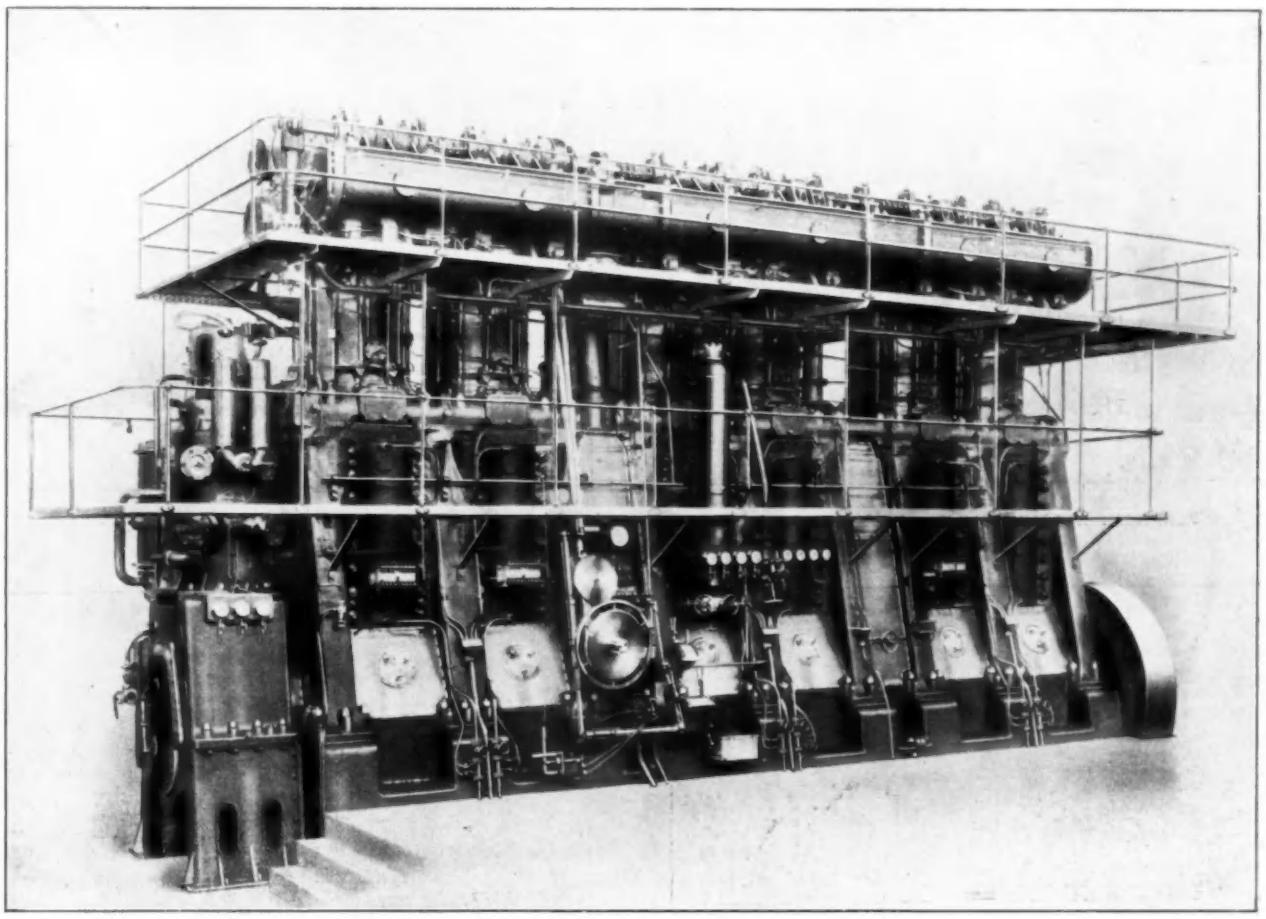
JOHORE CAUSEWAY, LOCK AND LIFTING-BRIDGE

LIFTING-BRIDGE OVER THE RIVER WENSUM AT NORWICH

# MARINE TURBINES AND ENGINES OF 1923

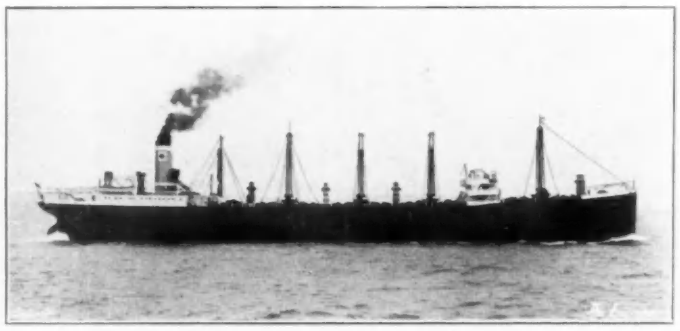



STARBOARD TURBINES OF THE ATLANTIC TRANSPORT LINER MINNEWASKA

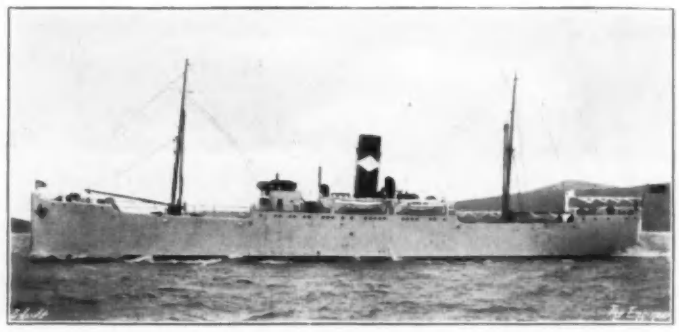


1250 B.H.P. RICHARDSONS - WESTGARTH - TOSI MARINE OIL ENGINE

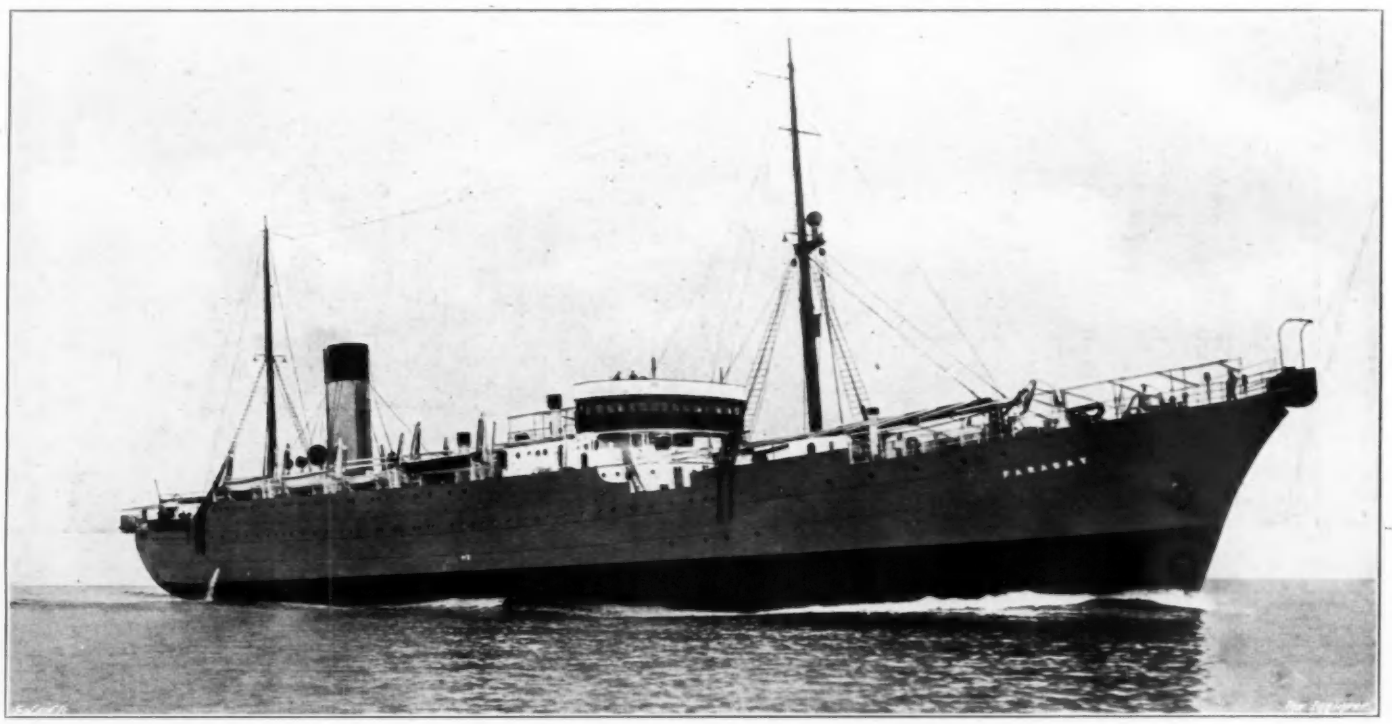
# SOME SHIPS OF 1923



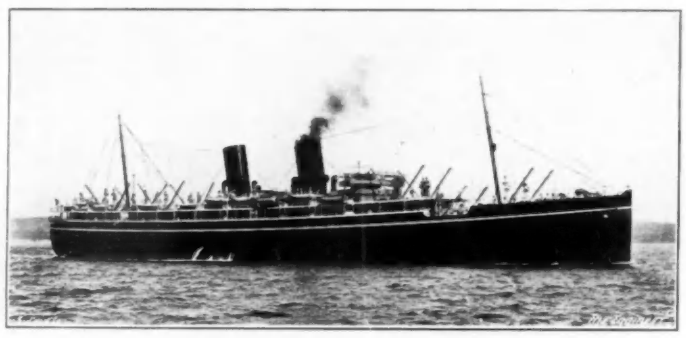
STEAM COLLIER BERWINDMOOR



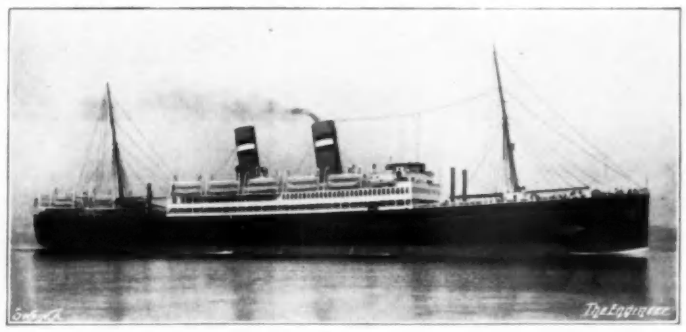
DIESEL-ELECTRIC FRUIT CARRIER LA PLAYA



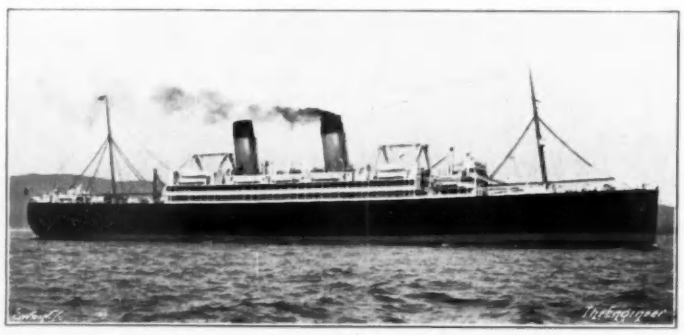
CABLE SHIP FARADAY



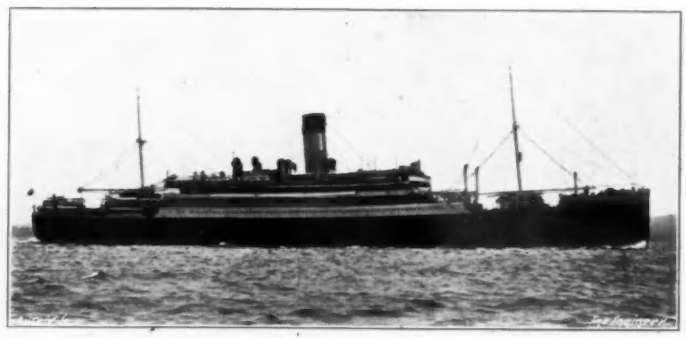
PENINSULAR AND ORIENTAL LINER MOOLTAN



HOLLAND-AMERICA LINER VEENDAM

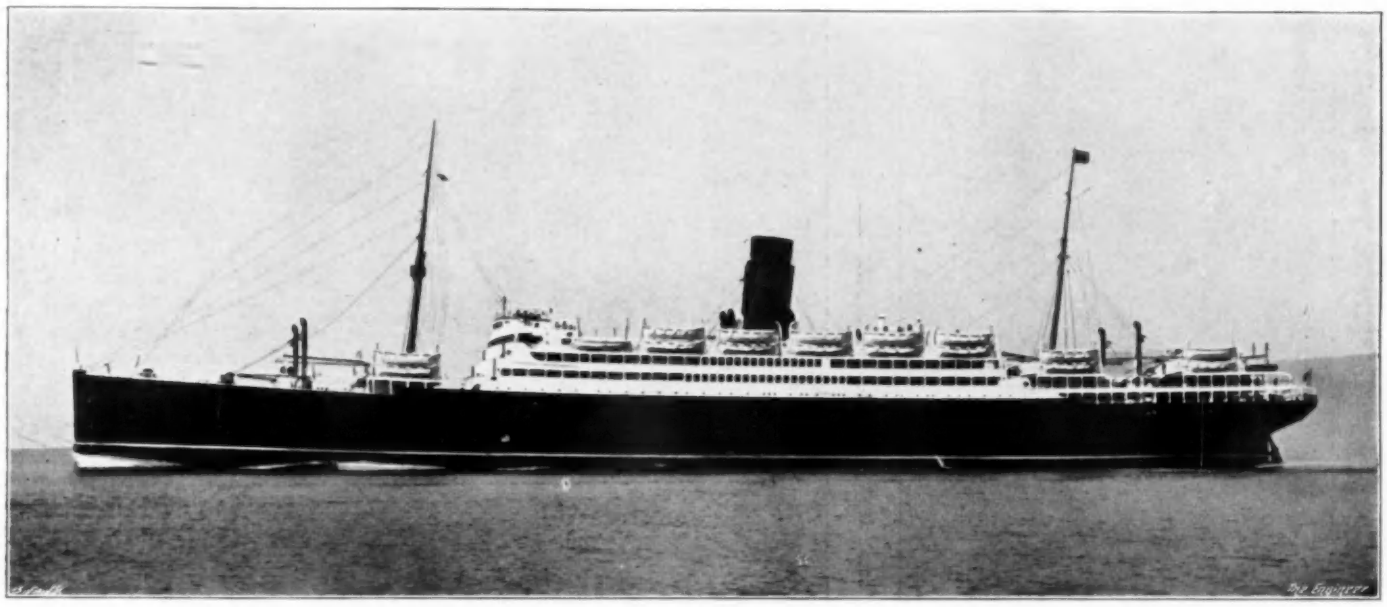


WHITE STAR LINER DORIC

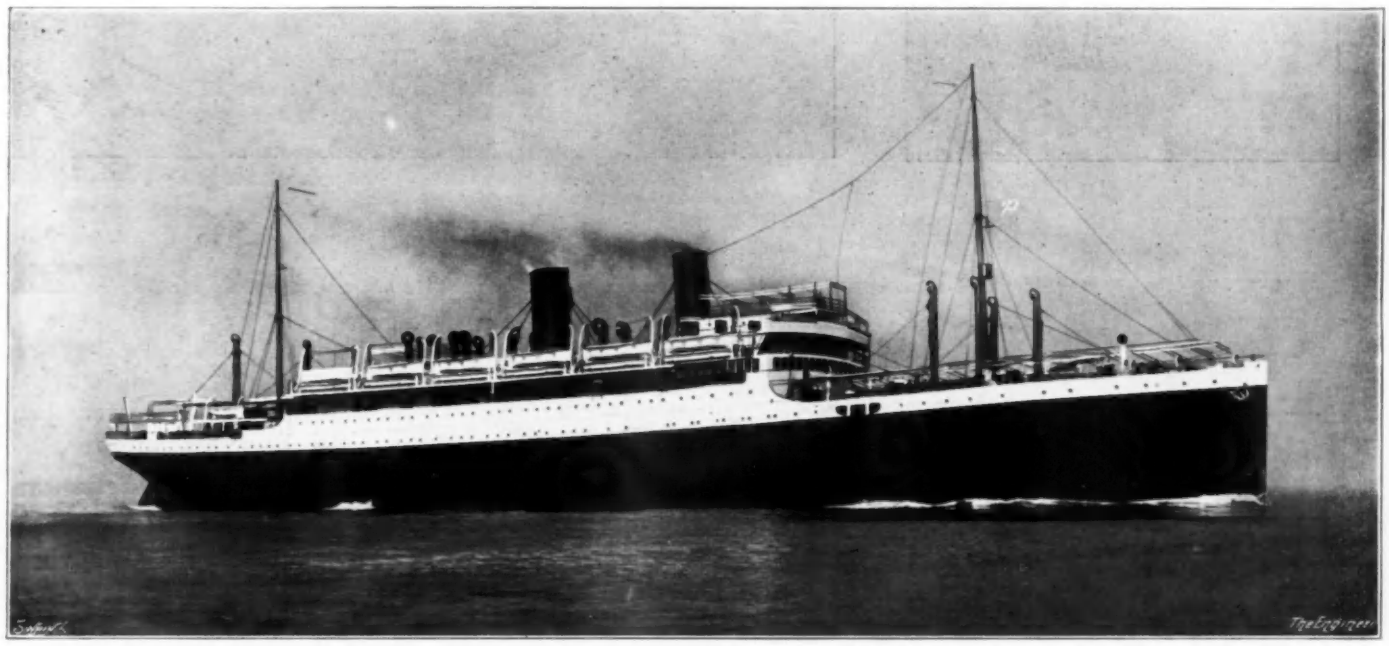


LAMPORT AND HOLT LINER VOLTAIRE

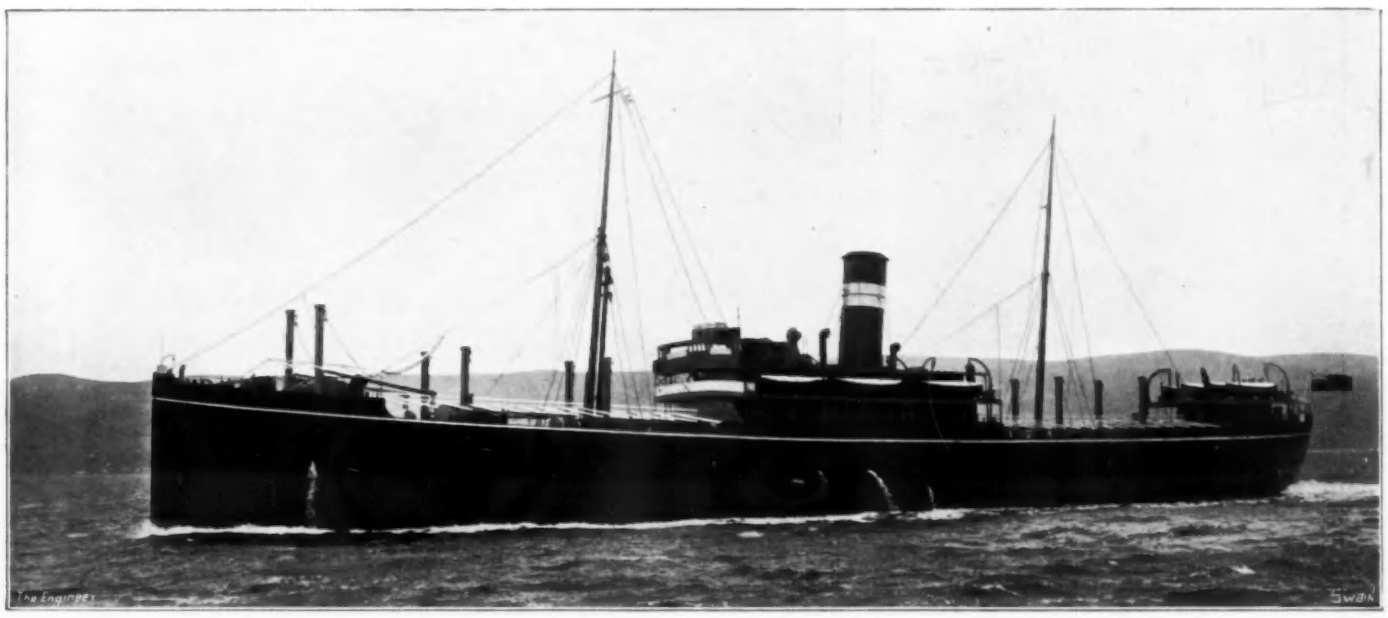
# SOME SHIPS OF 1923



CUNARD LINER FRANCONIA

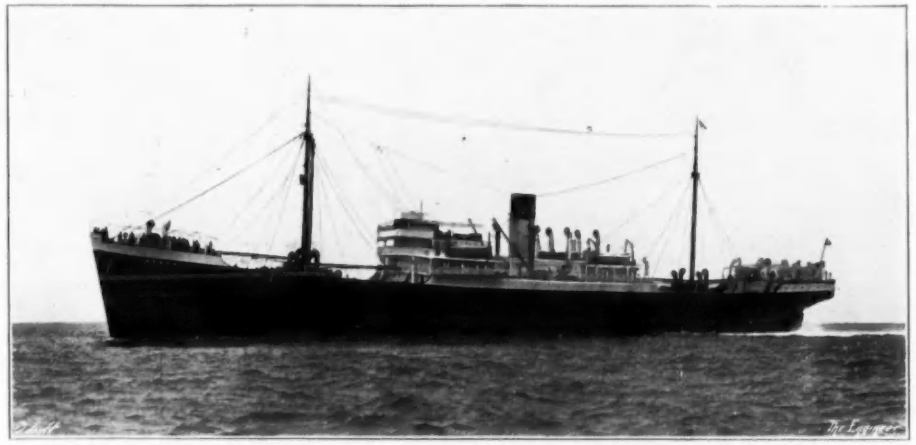


LINER CUBA OF THE COMPAGNIE GÉNÉRALE TRANSATLANTIQUE

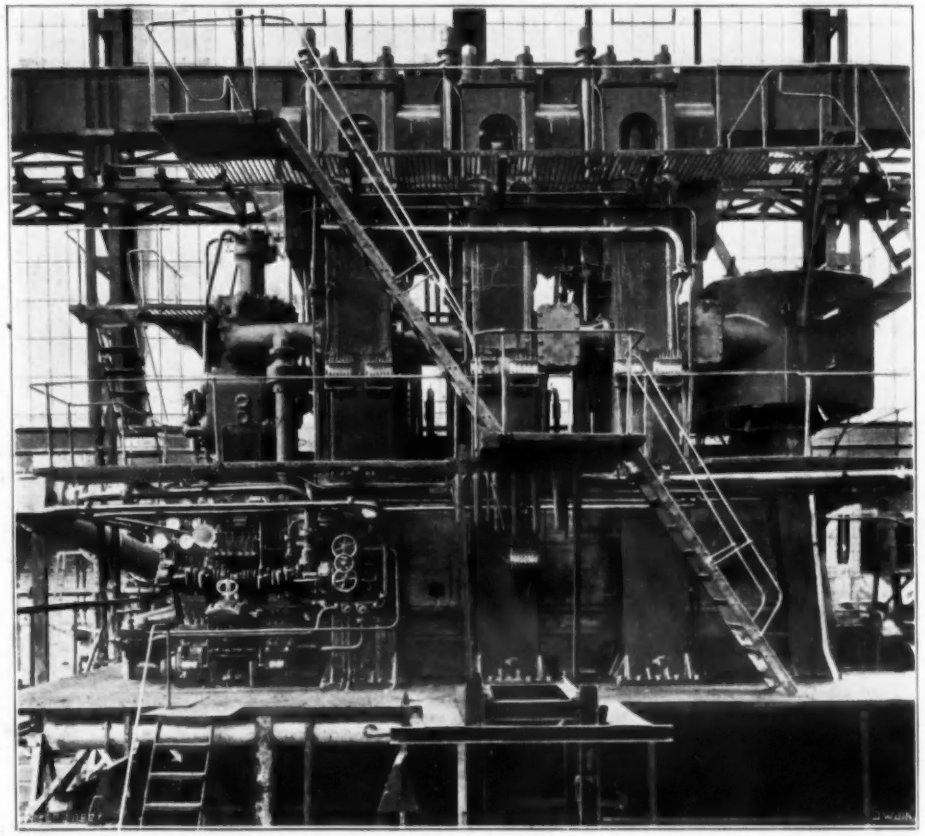


BRITISH INDIA STEAM NAVIGATION CO.'S MOTOR SHIP DALGOMA

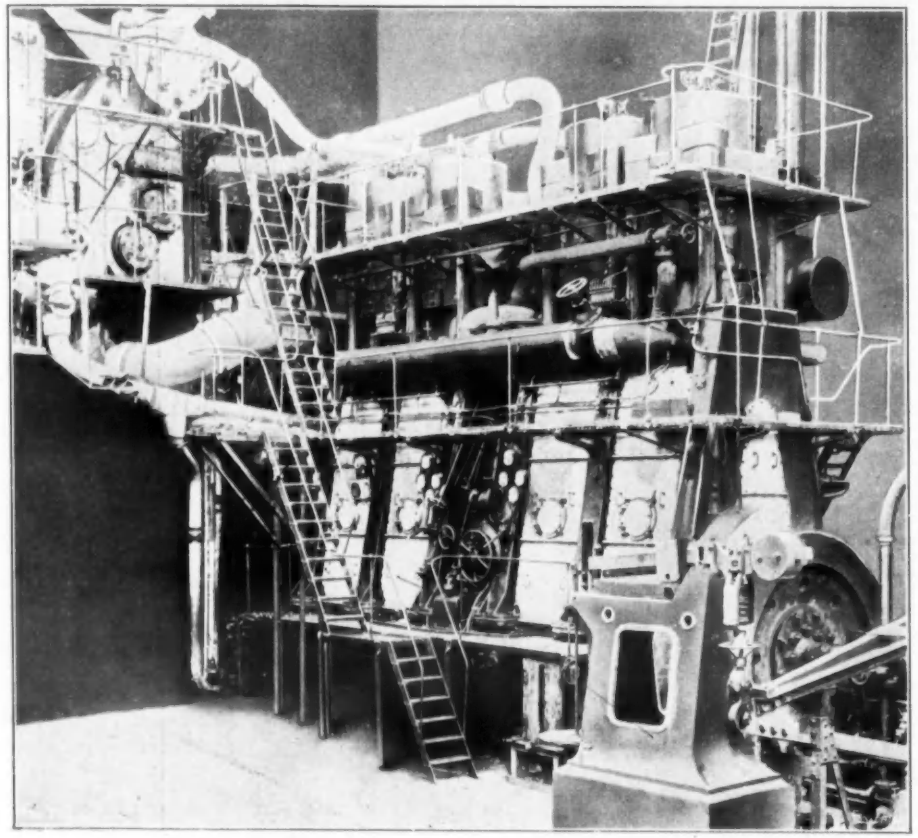
MacANDREWS AND CO.'S FRUIT-CARRYING MOTOR SHIP PIZARRO



OCEAN STEAM SHIP CO.'S MOTOR SHIP MEDON



NORTH BRITISH 2000 B.H.P. DOUBLE-ACTING TWO-CYCLE ENGINE



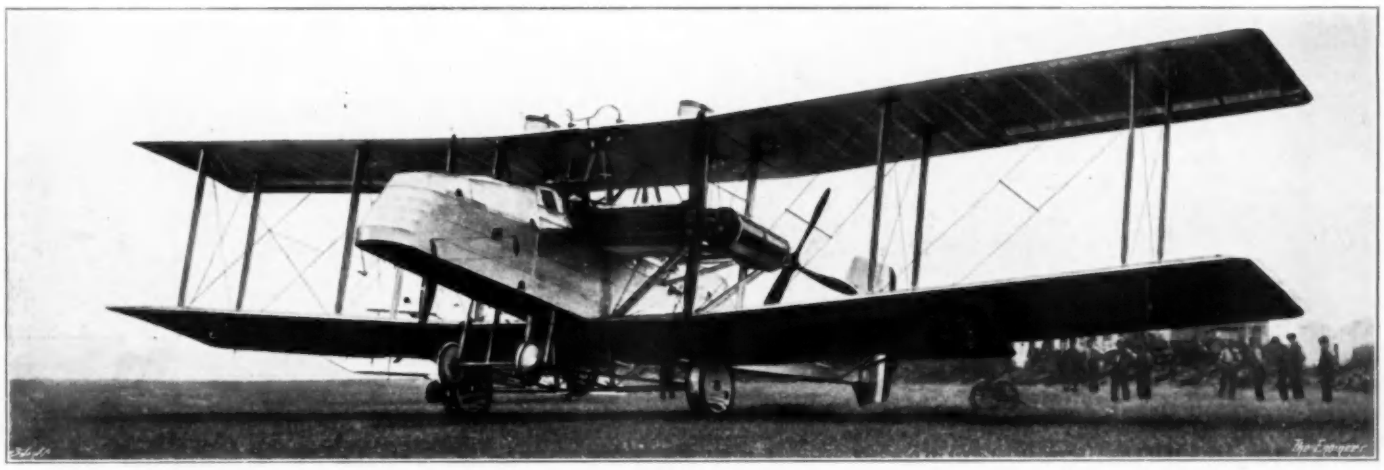
1250 S.H.P. SCOTT-STILL MARINE ENGINE

# SOME AEROPLANES OF 1923

FAIREY "FLYCATCHER" DECK-LANDING FIGHTER

ARMSTRONG-WHITWORTH "SISKIN" SCOUT

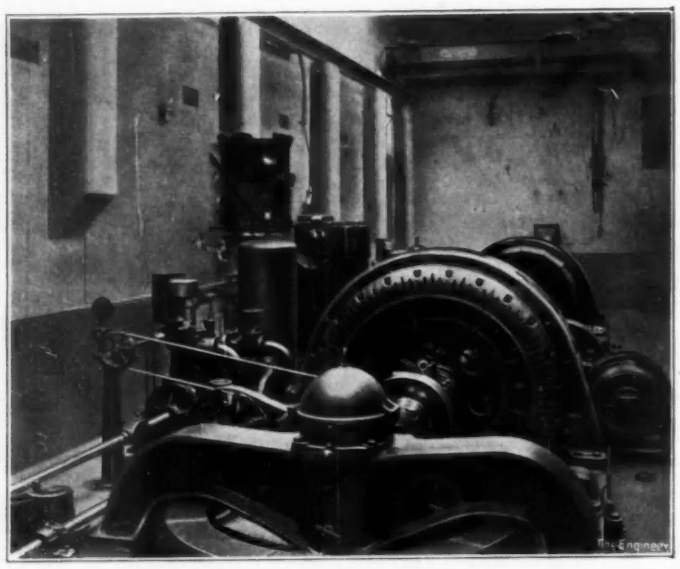
ARMSTRONG-WHITWORTH "AWANA" TROOP CARRIER



BOULTON AND PAUL "BODMIN" POSTAL OR MILITARY MACHINE

BRISTOL "JUPITER" FIGHTING MACHINE

# ELECTRICAL ENGINEERING IN 1923



INTERIOR OF YORK HYDRO-ELECTRIC POWER STATION

TURBINE GATE MECHANISM, YORK POWER STATION

MAIN CONTROL ROOM, BARTON POWER STATION

SWITCHGEAR, BARTON POWER STATION

WEMBLEY LABORATORIES, TUNGSTEN WIRE DEPARTMENT

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# THE ENGINEER.

*JANUARY 4, 1924.*

## 1923—A Retrospect.

MAY we not describe 1923 as the year of decreasing despondency? It began badly, and for engineers it continued badly almost to the end. Yet the trade of the country as a whole improved, and there was a fairly steady fall in the amount of unemployment, whilst with the ending of the boilermakers' lock-out and the placing of enormous contracts by the railway companies the position even in the engineering trades looked very much better in December than at any time in the preceding eleven months. We cannot, indeed, shut our eyes to the fact that some of the improvement is fictitious, the immediate outcome of steps taken to alleviate the distress of unemployment. Yet much of it is genuine enough to encourage the hope that the curve of industry, which has been asymptotic at a low level for many months, is at length turning once more to higher altitudes. We are conscious that hope of this kind has been nurtured several times during the past two years, and has died before it became a reality. It may so happen again; but looking at events broadly, we believe it will not. There is a livelier atmosphere throughout the country. The engineering trades, as we know, are not yet good, but even they are better than they were, and we are told that many other trades are in excellent condition. The building trade could scarcely be better, and the furnishing trades are doing admirably, whilst "sports" of all kinds have never, through all the months of depression, ceased to boom. How shall that be explained? What are we to understand by the enormous success of the Motor Car Show, by the fact, obvious to every observer, that in years of depression and unemployment the number of owners of cars, particularly small cars, has increased enormously? That fact has a philosophical issue to which we shall return presently. At the moment it is enough to note that trade as a whole has advanced sufficiently to encourage the belief that 1924 may do a little better than 1923.

It is the year of the Great Exhibition, certainly the greatest exhibition ever held in Great Britain, possibly the greatest ever held in Europe. Visitors from the four corners of the globe will come to London by their thousands between April and October. Not only will they bring with them a great deal of money, which they will leave here, but many of them will undoubtedly place with British manufacturers large orders for goods of all kinds. That the engineering industries will receive many of those orders goes without saying. In the two vast halls put at their disposal they will show what this country can do. They will not only show it to the world, but they will show it to themselves. Years of bad trade have made us a little despondent about ourselves, a little inclined to lose our confidence in our own capacity. The exhibition will act as a corrective. We shall see that British engineering is as good as any in the world, and in some respects better. We shall take new courage from that display and redouble our efforts with a livelier confidence. That we shall receive adequate support from the Dominions, Colonies, and Dependencies associated with Great Britain is assured by the sympathy of the Colonial Premiers, whose pregnant visit to these islands has only recently ended. We have, it is true, failed to do what they wished. The scheme of Empire economics will not yet come into being, but the ties that bind the children of the Empire to the Mother Country are too strong to be snapped by a disappointment of that kind. Our trade with them will, we are confident, abate not at all, and will rather receive a new impetus from the Great Exhibition.

We have alluded to the curious fact that, despite the depression in industry, more motor cars are seen on our streets than ever before, and asked for an explanation of that anomaly. An answer which has been given is very significant. It is said that few of the smaller cars are paid for outright, but are bought on the hire-purchase system. The owners mortgage the future to pay for them. Why? Because there is a feeling of instability, because everyone is living for the day, being uncertain what the future may bring forth. We are inclined to see a good measure of truth in that view, and if it be true, it is then, as we say, significant. Hitherto stability has been the bulwark of Great Britain. We prided ourselves upon it in all our affairs. We watched other nations flying from one thing to another. We saw Governments rise and fall rapidly, we saw policies change fitfully, we witnessed revolutions and depositions, and said "none of these things can happen here. John Bull is too stolid to be moved suddenly. He knows to-day what he is going to do to-morrow, next year, ten years hence. He will always be the same; we can confidently make provision for the future." All that has changed; we are in a position of chronic uncertainty. We do not know by whom we are to be ruled, by how much we are to be taxed, or what new policy may be sprung on a restless nation. Even our social and moral laws seem to be hanging dangerously near the brim of the melting pot. In such circumstances it is not strange that people live for the day and purchase happiness by mortgage. But the condition is not a healthy one. We need more than anything stable government and a return in all classes of that feeling of responsibility which only exists when the future is reasonably clear.

It is a noteworthy fact that the year was very free from industrial troubles. Apart from the boilermakers' dispute, there was not a single one of much consequence. That does not mean that there were no discussions, but that they were settled without resort to strikes or lock-outs. The boilermakers' dispute was unfortunately one of the longest on record. It arose from an agreement as to night shift and overtime in shipyards, which was reached by the Shipbuilding Employers' Federation and the Federation of Engineering and Shipbuilding Unions on February 9th. A pooled vote of the affiliated unions was taken and the returns made on March 20th showed acceptance of the terms. Three unions, however, the Boilermakers, the Operative Plumbers, and the Woodworkers, refused to be bound by it, and the first-named threatened to withdraw from the federated trades rather than do so. Local strikes began in the North-East Coast, and at length the employers posted notices, on April 23rd, locking out members of the three recalcitrant unions. Efforts were made by the Ministry of Labour to effect an agreement, but without avail so far as the boilermakers were concerned, although the other two unions returned to work. A few weeks later the boilermakers were expelled from the Federation, and they then claimed that they had in fact ceased to be members before the agreement was signed and were therefore not bound by it. Various efforts to conclude the dispute followed, but were fruitless, and when some prospect of success was in sight early in July the General Council of the Trade Union Congress expressed its support of the boilermakers. This action probably influenced a ballot, which resulted in a large majority against acceptance of the agreement. And so the dispute dragged on week after week, doing enormous damage to the shipbuilding and engineering industries. We need not follow its

further progress in detail. It is sufficient to say that it was not until the end of October that the end appeared to be approaching. On the 22nd and 23rd of that month a national conference, called by the Boilermakers, met at York. It led to a meeting between the Shipbuilding Employers' Federation and the Boilermakers' Society on November 14th and 15th and 16th. On the last of those days the Boilermakers agreed to return to work on condition that certain points were considered by a joint committee, and that if the committee failed to effect an agreement the matter should be submitted to the Industrial Court. This agreement was ratified by ballot, and thus after seven months of idleness work was resumed. It is estimated that the dispute cost in loss of wages and so on some £10,000,000 and affected 60,000 workers in all. The harm that it did to the country it is impossible to estimate. A good deal of repair work was sent abroad and nearly all our shipyards were rendered practically idle. The only large firm not affected was Harland and Wolff, Limited, which, being outside the Employers' Federation, did not post notices.

The only other dispute which calls for attention is the railwaymen's. Fortunately, it had a very different course; arbitration proceeded steadily from the opening and there was never any stoppage of work. One of the matters in question was the reduction of the war bonus of 16s. 6d. paid to railway shopmen. Negotiation began early in the year, but as little or no progress had been made towards a settlement by the autumn, the railway companies proposed to submit the question of railway labour in general to a special court. This court sat under the chairmanship of Sir William MacKenzie, and at the very end of the year issued its report. On the whole, that report was in favour of the men. The companies sought by various reductions in wages to save something like 3¾ million pounds per year. Under the terms of the award the saving effected will be very much less.

With the technology of engineering in its various branches we deal at some length in special articles in the present issue. There is nothing very remarkable in the record. The most striking development of the year is, perhaps, the progress of the marine oil engine. The manufacture of such engines is now firmly established in this country, and already there are signs that characteristic British designs will before long be evolved and that dependence on foreign designs will cease. We have been feeling our way through the experience of foreign builders, but now that we are fairly started upon manufacture on a large scale, departures from the original foreign designs is becoming evident, and it is not too much to expect that in a few years time even the foreign names will be given up and pure British marine oil engines will propel British ships. In this connection it is perhaps not inapprorpiate to ask if the time has not come to drop the word Diesel altogether. Strictly speaking, the "Diesel" is a type of engine, not a cycle, for the cycle was originated by Mr. Ackroyd-Stuart. Many engines of to-day which are called "Diesels" have little or no resemblance to Diesel engines, and it seems a pity to perpetuate the name in connection with them. We no longer speak of Otto or Daimler engines, and there is no more reason to speak of Diesel engines.

In the realm of steam engineering the most evident movement of the day is that towards ever higher pressures and temperatures. A working pressure of 350 lb. is now ceasing to cause remark, and in a few years will be common. Pressures three times as great are in prospect or under actual trial, whilst in one boiler, the Benson, which is being made at Rugby by the English Electric Company, the critical state of water is reached and the pressure is no less than 3200 lb. with a temperature of 706 deg. Fah. These very high-pressure boilers open up problems quite unconnected with their thermodynamical value, and even apart from ordinary questions of the strengths of materials. There is reason to suspect that steam and water at high pressures and temperatures attack steel very actively if any free oxygen is present. Experiments of all kinds are to be encouraged and supported, but it is probable that collateral knowledge, or lack of it, will compel us to advance relatively slowly, satisfying ourselves, at each step towards higher pressures, that we do in fact know all about them before venturing on the next.

But whilst definite progress at the upper end of the heat scale is being made, less can be said about the lower end. Apart from such efforts as those of Ramsay and Ljungstrom to produce air condensers for special purposes, there is no evidence yet of any novel attack upon the question of condensation. The cost of circulating water remains a very large item in power stations, and it is really surprising that the scientific imagination gives us no serious clue to any method of reducing it materially. But an extraordinarily interesting version of the condenser is that in which it becomes a steam boiler as in the binary-vapour plant of Mr. Emmet. In this plant the primary working fluid is mercury, which is evaporated at 35 lb. pressure. The vapour, after developing power in a turbine, is condensed back to mercury in a boiler. The steam generated in the process of cooling the mercury drives another turbine. A 1500-kilowatt plant working on this principle at Hartford, Conn., was described in our issue of November 23rd. Here again the practical problems are at least as important as the thermodynamical questions.

It would not be right to omit from this very general survey of the year a word concerning the most appalling catastrophe that has occurred in the world within the limits of human history. On September 1st Japan was stricken by an earthquake, which laid more than half the capital in ruins and utterly destroyed the chief seaport. It is estimated that nearly one hundred thousand people lost their lives and that some four hundred thousand houses and buildings were thrown down or burnt. With characteristic energy and with a philosophic resignation bred of former disasters, the Japanese are setting about the rebuilding of the ruined cities and the restoration of their trade. To them we take this opportunity of offering our sympathy in their distress and our earnest hope of a rapid recovery from it.

In conclusion, we desire to say that to our minds, and we believe to the minds of all men who are sincerely interested in the progress and welfare of our land, the outstanding need of the day is a period of tranquility and stability. There are people who cannot see a fly-wheel revolving steadily and invisibly without at once desiring to prod it to make sure that it is moving, or to stop it altogether and reverse it. We are suffering at present from such restless spirits. The even rotations of the industrial fly-wheel were disturbed by the war; our object should be to restore them as quickly and as quietly as possible. The political outlook is obscure, but we may express the hope that whatever arrangement is reached for the government of the country, the need for stability will be recognised, and that anything approaching a revolutionary policy will be avoided.

## Steamships of 1923.

DURING the year which has just closed, the abnormal depression in the shipbuilding and marine engineering industries was further accentuated by the long protracted dispute with the boilermakers. The combined effect of surplus world tonnage, disturbance in international trade and labour unrest, was to create an almost unparalleled situation. Districts varied considerably, but probably one of the worst hit was the Wear, where only seventeen ships were launched, making the lowest return since 1876, and the third lowest output on record. On the other hand, there were shipbuilding centres which fared better, and with the various returns before us it is clear that despite bad times and the many difficulties which had to be faced, much progress was made and no effort was spared by either shipbuilders or engineers to maintain the supremacy and prestige of British shipbuilding. The story of the part which was played by the motor ship and the marine oil engine is told elsewhere in this issue. In this article, therefore, we propose to confine ourselves to the steamships of the year.

### Some Large Vessels.

The most important contribution to the year's tonnage was, without doubt, made by Harland and Wolff at Belfast and Govan. Happily for that firm, the work at these establishments was not interfered with by the boilermakers' strike, and there was no interruption of it. Indeed, the output of these yards for 1923 falls little short of that in the preceding year, and totals upwards of 100,000 tons of shipping, with over 70,000 indicated horse-power of engines of all types. In these figures several of the largest ships of the year, some of which are illustrated in to-day's Supplements, are included. The Minnewaska —Fig. 1—with which the Atlantic Transport Line opened direct passenger service from London to New York on September 1st last, is a noteworthy example. With a length of 625ft. and a breadth of 80ft., this new type of ship has a measurement of 21,716 gross tons. She is equipped to carry 369 first-class passengers, and her cargo holds will take 17,000 tons deadweight, a record, we believe, for her size. The machinery of the ship was described in THE ENGINEER of June 15th, and her starboard turbines are shown in one of our Supplements to-day. Twin-screw Brown-Curtis turbines, each of 9000 shaft horse-power, driving propellers through single reduction gearing, are fitted and are designed for a service speed of about 18 knots. Steam is generated in water-tube boilers, and all the engine-room auxiliary machinery is electrically driven. The gear wheels for the Minnewaska were among some of the largest recently cut in the builders' shops. The time taken to cut each was about two months with the machine in continuous operation. A sister ship, the Minnetonka, is now approaching completion.

Another large ship of the year was the White Star liner Doric, which has proved a popular vessel in the Canadian service. She is a 600ft. vessel with a gross tonnage of 16,484 tons, and is also fitted with twin-screw single reduction turbine machinery. Two other large liners, completed by Harland and Wolff at Belfast, are the Mooltan and the Maloja, for the Peninsular and Oriental Steam Navigation Company. In one of our Supplements an illustration of the former is given. The Mooltan is 625ft. in length, 73ft. in breadth, and 44ft. in depth, with 20,800 tons gross tonnage. Her propelling machinery comprises two sets of inverted quadruple expansion reciprocating engines. They are balanced on the Yarrow-Schlick-Tweedy system, and have cylinders of the following diameters:—33in., 47in., 67½in. and 97in., with a piston stroke of 60in. Oil-fired boilers, with Todd burners, working under forced draught, are installed, steam being generated at 215 lb. per square inch pressure and superheated by 100 deg. Fah. With these two new ships the P. and O. Company is now in a very strong position as regards Eastern passenger and cargo trade. Another vessel delivered during the year from Belfast was the Veedam for the Holland-America Line. This vessel is illustrated in a Supplement to-day, and is a sister ship to the Volendam completed last year. We also illustrate two ships built by Workman, Clark and Co., Limited. The first is the twin-screw Lamport and Holt liner Voltaire, which was launched at Belfast in August and entered its owners' service in November. The Voltaire was specially designed for mail service between New York and the river Plate, and is a first-class liner with all the modern improvements. The following are her principal dimensions:—Length overall, 526ft.; breadth, 64ft. 3in.; depth, 43ft.,

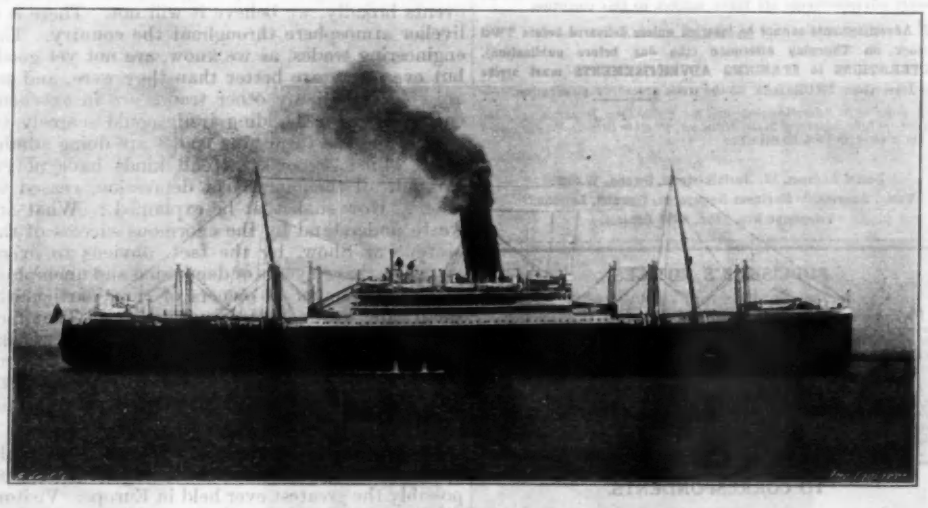


FIG. 1—ATLANTIC TRANSPORT LINE'S S.S. MINNEWASKA

with 19,200 tons displacement. Two sets of quadruple expansion balanced engines with 7500 total indicated horse-power are fitted. There are four large single-ended and two large double-ended return tube boilers, arranged in two stokeholds and furnished with forced draught oil burners of the "White" type and superheaters. The auxiliary machinery includes three 90-kilowatt turbo-generators for power and lighting. Special attention has been given to the ventilation of the ship so that the varying conditions of service are fully met. A different type of ship, which we also illustrate, is the self-trimming shelter-deck type coal carrier Berwindmoor, built for the Berwindmoor Steamship Company, Limited. She was designed by Esplen and Sons, Limited, consulting engineers, Liverpool, and carries about 10,000 tons deadweight. The dimensions of this ship are: Length, 435ft.; breadth, 56ft.; and depth to shelter deck, 38ft. 6in. The triple-expansion engines, with cylinder bores of 27½in., 45½in. and 76in., with 54in. stroke, were also constructed by the builders.

### Ships Built on the Clyde and Tyne.

On the Clyde several large ships were completed. An outstanding vessel was the Cunard liner Franconia, built and engined by John Brown and Co., Limited, at Clydebank. An illustration of this ship is included in a Supplement to-day. The Franconia marks a departure from the owners' and builders' usual practice, in that she has been specially designed for long ocean cruises as well as for the usual Atlantic services. This double purpose is reflected in her extremely comfortable and well-arranged passenger accommodation and the ample provision which has been made for sport and exercise. The new ship, which is the second of the name, has a length of 623ft. with 73ft. 6in. breadth and a gross tonnage of over 20,000 tons. Her machinery is of the compound Brown-Curtis type, driving two propellers through double reduction gearing. The total ahead power developed is about 12,500 at a speed of 90 revolutions per minute, and the astern power is 70 per cent. of that ahead. This ship has proved quite popular on her North Atlantic runs and on the world cruise she is now making. Another Clydebank liner which is not so far advanced as it might have been had not the boilermakers' strike taken place, is the Oronsay, a 658ft. 20,000-ton passenger liner for the Orient Steamship Company, Limited. Geared turbine machinery of about 20,000 shaft horse-power will be fitted. The sister boat, the Orama, is being built at Vickers' Barrow yards and is in a slightly further advanced condition. John Brown and Co., Limited, also completed during the year a private steam yacht, built to the designs of G. L. Watson and Co., of Glasgow, for Captain A. S. Cochran. She was described in THE ENGINEER for August 10th. Two cable steamers were launched at Clydebank, to which we shall refer later. At Dalmuir, William Beardmore and Co., Limited, have completed the passenger and cargo ship Conte Verde, a sister vessel to the Conte Rosso, of the Lloyd Sabaudo Company, which entered that company's service last year. The Conte Verde has a gross tonnage of over 18,500 tons and is propelled by double reduction geared turbine machinery of about 21,000 shaft horse-power. Other notable ships of the Clyde last year were the Fezara, built for the Khedivial Mail Steamship Company, Limited, London, by Alexander Stephen and Sons, Limited, of Linthouse. Like her sister ship the Femaka, this 10,250-ton vessel is driven by geared turbines and her boilers are fitted with the Clyde oil fuel burning system. She was described in our issue of February 16th, and on June 8th we gave a complete account of the Clyde system and its various applications. The same builders constructed the 17,000-ton steamship California for the Anchor Line (Henderson Bros.), Limited. Weir's closed feed system is fitted to the condensers and the navigating instruments include a Sperigyro compass and automatic course recorder.

At Fairfield there was no launch during the period under review, but the Anchor-Donaldson liner Athenia, a vessel of 12,000 gross tons, with geared turbine machinery of 8700 shaft horse-power, was finished and put into service. Another vessel illustrated in one of to-day's Supplements is the liner Cuba, built by Swan, Hunter and Wigham Richardson, Limited, for the Compagnie Générale Transatlantique. This vessel will be used for the company's service between France and Central America, and has the following principal dimensions:—476ft. between perpendiculars; moulded breadth, 62ft.; and depth, 38ft. The machinery is of the Metropolitan-Vickers-Rateau geared turbine type with the double reduction gears in a floating frame built under the McAlpine patents. There are twin screws, each turbine developing 4500 shaft horse-power at 112 revolutions per minute, the corresponding turbine speed being about 3350 revolutions. Several voyages have been made with highly satisfactory results. Swan, Hunter's have been more fortunate than some other firms and have launched during the year seventeen ships, representing a total gross tonnage of 44,206 tons. A new liner on the Southampton-New York service last year was the United States Line's Leviathan. It will be remembered that this ship was the Vaterland, originally built by Blohm and Voss for the Hamburg-America Line, and described in THE ENGINEER of May 22nd, 1914. After the outbreak of war she passed into American hands, and after doing trooping work was reconditioned at the Boston Navy Yard and the Newport News Shipbuilding and Dry Dock Company. The alterations made to the superstructure and accommodation, together with the machinery, increased the gross tonnage to 59,956 tons, as against the 56,551 tons of the White Star liner Majestic, which ship is a little longer.

### A Few Special Ships.

During the year three cable ships were launched. We illustrate in a Supplement the Faraday, built by Palmers Shipbuilding and Iron Company, Limited, for Siemens Bros., of Woolwich. The ship and her cable machinery were described and illustrated in THE ENGINEER for March 16th and July 27th respectively. Only a few weeks ago the Faraday returned from a successful maiden voyage to Nova Scotia. At John Brown's Clydebank yard two further cable ships were launched; they were the Mirror, for the Eastern Telegraph Company, Limited; and the Norseman, for the Western Telegraph Company, Limited; each ship has a tonnage of 1850 with engines of 1500 horse-power. The dredgers built during the year were comparatively few. We have to record a grab hopper dredger of 1500 tons and engines of 2000 indicated horse-power, and a small bucket dredger of 130 tons with 300 indicated horse-power machinery. Both were constructed by Wm. Simons and Co., Limited, of Renfrew, for colonial authorities. At Port-Glasgow, Ferguson Bros., Limited, completed a 600-ton bucket type dredger, with engines of 800 indicated horse-power, for British owners, besides shipping dredging plant abroad.

### Reciprocating Engines, Turbines and Gearing.

The returns show that for small cargo steamers, oil tankers and medium passenger vessels, the steam reciprocator is still favoured to a large extent, and that this class of machinery was predominant in the engine shops, both on the Clyde and North-East Coast. For the larger and higher speed vessels the geared turbine presents a more satisfactory solution. Both single and double reduction gears for large powers were constructed during the year, and it may be said that the uncertainty which was aroused in the minds of shipowners regarding double-reduction gearing—largely as a result of gears built in the years immediately succeeding the war period—has largely given place to confidence. We cannot point to new features in design or construction, but would emphasise the improvement which has been made in workmanship and materials. A letter to THE ENGINEER from Palmers Shipbuilding Company, Limited, which appeared in our issue of September 8th last year, may still be taken as indicative of the firm's confidence in gears of the rigid type, while a similar recent letter from Swan, Hunter and Wigham Richardson, Limited—see THE ENGINEER, November 23rd—recounts the success which that firm has had with gears of the floating frame type. Before leaving the subject of gearing, reference may perhaps be made to a new and novel arrangement of single-reduction gears adopted by Blohm and Voss, of Hamburg, for the twin-screw liner Albert Ballin. Full details of this ship and its machinery were published in THE ENGINEER for September 14th and 21st. In the arrangement referred to the gear wheel is housed in the centre of a group of four turbines—high-pressure, first and second intermediate-pressure and low-pressure—and the pinions are driven from either end. By this means it is claimed that end thrust is eliminated, torsional stress in the pinions is reduced, and a more compact turbine unit is achieved.

### Boilers and Mechanical Stoking.

The Scotch marine boiler continues to hold its position, and we have to record little progress in the use of the water-tube boiler in commercial ships. True it is that some of the larger ships are so fitted, but on the whole, especially when maintenance is taken fully into account, the Scotch boiler would seem to have advantages. In an article appearing in THE ENGINEER of January 12th, an account was given of mechanical stokers of the Underfeed pattern fitted to a Babcock and Wilcox type marine boiler on the ss. Parigi. Further particulars of this system were given by Mr. Muller in a paper read before the Institution of Naval Architects in Holland—see THE ENGINEER of September 14th. Improvement along these lines and also with pulverised fuel indicate new directions of advance. The name of Howden has long been associated with forced draught systems for marine work, and the firm has now taken up the very simple Ljungström air pre-heater, which has already given good results on test. In our issue for August 3rd we described a new uptake superheater for Scotch marine boilers, which was designed by T. Sugden, Limited, of London, to overcome difficulties which have been experienced with superheaters of the smoke-tube type.

### Some New Developments.

In illustration, Fig. 2, we show a view taken in the keel of a Furness built ship. It clearly demonstrates the ready access to pipe connections which the duct keel system gives. At the present time there are seven vessels of this type being built in Great Britain, five of which are motor ships and the others large passenger liners.

Turning to steering gears, reference may be made to the Flettner rudder. Since the Odenwald installation was completed—see THE ENGINEER for June

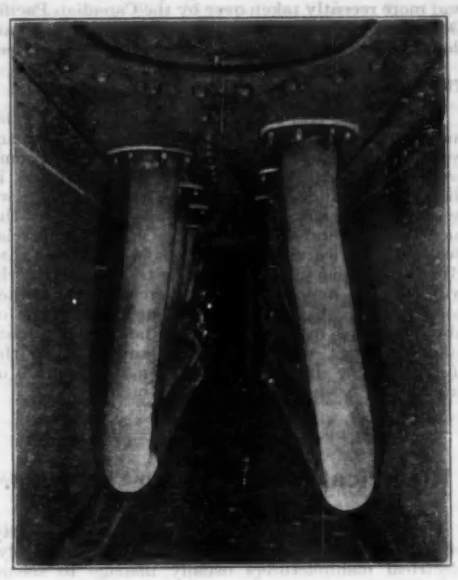


FIG. 2—DUCT KEEL

22nd—further progress has been made, and a new three-surface rudder is being built for commercial testing. Brief reference has already been made to the "Sperigyro" compass and the automatic course recorder. The Cunarder Laconia was the first British ship fitted with this automatic helmsman or gyro-pilot. Similar instruments of the Anchütz type are used on the German liners, and automatic course steering by the agency of wireless direction-finding signals is a probable new development. When in Holland recently we saw several five-bladed propellers which are to be used to correct vibration on certain

FIG. 3—FIVE-BLADED PROPELLER

ships. Fig. 3 shows one of these propellers, made by Bull's Metal and Melloid Company, Limited, of Yoker.

### Oil in Navigable Waters.

The Act which came into force at the beginning of 1923 forbidding the discharge of oily bilge water into the sea within the 3-mile limit has been instrumental in bringing forward some ingenious oil-water separating devices. An oily-water separating barge, designed and built by Smiths Dock Company, Limited, was described and illustrated in our issue of January 26th, and several of these barges are now doing good work in various ports and docks. Later in the year—see THE ENGINEER of June 29th—we illustrated the Knight and Smith oily ballast water separator, which may be built into the ship, and more recently another apparatus—the Rocket oil separator—was built under the Alexander patents by the General Oil Conservancy Company, Limited, London.

### Repairs and Reconditioning.

Although the boilermakers' strike deflected much repair work to Holland and the Continent, several important ships were dealt with in British yards These vessels include the Arcadian, of the Royal Mail Steam Packet Company, Limited, and the Belgenland, for the Red Star Line, both of which were reconditioned at Belfast. The Homeric is now undergoing repairs in the same yard. In Glasgow work on the C.P.S. liner the Empress of France has been started at William Beardmores, Dalmuir, while at Southampton the Cunarder Mauretania is undergoing

extensive turbine repairs in the hands of John Thornycroft and Co., Limited, which firm has carried out a good deal of repair work throughout the year. New repairing yards are to be built for J. S. White and Co., Limited, at Southampton, and the Bootle Engine Works, formerly belonging to the Allan Line, and more recently taken over by the Canadian Pacific Ocean Services, will now be operated as a repair department of William Beardmore and Co., Limited.

**The Outlook.**

Towards the year's end, and even before the settlement of the boilermakers' strike took place, there were signs that confidence was returning, and some new orders were placed. The prospect in view is distinctly brighter than that of a year ago, and we feel that the worst has been passed. With the increased new and efficient tonnage in the commercial fleets of America and Germany, it is very clear that British supremacy in the carrying trade of the world will only be maintained under greater and keener competition. A policy of constant replacement of obsolete ships by vessels of the newest and most efficient design will be alike advantageous to the shipowner, the shipbuilder and the many branches of engineering associated with the industry.

## Electrical Engineering in 1923.

EVEN when trade is generally bad and the majority of industries are suffering more or less intensely, electrical manufacturers usually manage to secure sufficient orders to keep them fairly busy, and whilst the past year was far from one of great prosperity, for the most part the electrical firms had little to complain about. Electricity is so useful and is so essential to manufacturers and others that bad times do not always seriously retard electrical progress. In fact, it is when conditions are difficult that the need for electrification is most keenly felt, and when steps are often taken to introduce new plant with a view to making money. The electrification of railways invariably results in increased suburban traffic, and the more the revenue falls off, the more rapidly do railway directors make up their minds to electrify. Similarly, in many industries in which difficulties are experienced in the direction of earning profits, electrical plant is often put down to diminish working expenses or to speed up production. Again, the shopkeeper who finds that trade is bad very wisely spends money on more adequate and more effective illumination with the object of drawing custom. In the home electricity is frequently introduced with a view to saving labour and thereby minimising servants' wages. Bad times, therefore, do not affect the electrical industry to the same extent as many older industries which are less essential to the welfare of the country.

Although the past year was not an exceptionally notable one from the point of view of new developments, save, perhaps, the remarkable progress in wireless telephony, a considerable amount of heavy electrical engineering work was undertaken. One of the most important new power stations opened was the Barton station of the Manchester Corporation, part of the switchgear for which is illustrated in one of our Supplements. During July the King opened a large station at Edinburgh, whilst the reconstructed station at Peterborough was put into operation in September. The commencement of the first super-power station at Barking was another important event. The Linton Lock hydro station—illustrated in a Supplement—and the new station at Belfast, were also opened during the period under review. On May 28th, a 30,000-kilowatt set was started up by the Prince of Wales in the new Rotherham station, and a number of important extensions were carried out at Stoke-on-Trent, Halifax, and elsewhere. On the manufacturing side one of the most important developments was the opening of the General Electric Company's extensive research laboratories at Wembley. These laboratories, which we also illustrate, are by far the largest attached to any British electrical firm, and the General Electric Company is to be congratulated on having recognised the value of research and on having set a good example. Active preparations were made during the period under review for the British Empire Exhibition, which is to be held at Wembley, and there is not the least doubt that the electrical industry will be well represented. Acting on behalf of the electric supply undertakings of this country, the Electrical Development Association is taking a space of 10,000 square feet for demonstrating the use of electricity in the home and for small industries.

**Turbo Generators.**

The main feature of the year's work at the Heaton Works of C. A. Parsons, Limited, was the continued development of the large high-speed two-pole 50-period turbo-alternator. Five 12,000-kilowatt machines of this type are being supplied to the order of the South African Railway Commissioners. Three of these sets have already been despatched, and one of them is to be shown at the British Empire Exhibition. During the period under review, or, rather, from the commencement of the company's financial year—April 1st, 1923—the total output of turbo-alternators represented 110,000 kilovolt-ampères, and of that capacity 100,000 kilovolt-ampères are provided by 50-period 3000 revolution per minute machines. Surface air coolers, for the ventilation of alternators on the closed circuit system, were built for alternators with an aggregate capacity of 78,000 kilovolt-ampères, and surface condensers for turbines with an aggregate output of 80,000 horse-power. Alternators on order or under construction represent a capacity of 460,000 kilovolt-ampères, and 320,000 kilowatts of this capacity will be provided by 50-period 3000 revolution per minute machines. Orders for surface air coolers represent 420,000 kilovolt-ampères. The company has recently turned its attention to the manufacture of slow-speed alternators of the "open" type, and suitable for coupling to water turbines, &c. Several small alternators, ranging from 500 to 2500 kilowatts capacity, were constructed for coupling to steam turbines by means of gearing, so as to free the turbine from the speed limitations imposed by the frequency of the supply, as, for example, when the frequency is less than 25 periods per second. Several single-phase direct-coupled turbo-alternators were constructed, including a 1500-kilowatt set, running at 5400 revolutions per minute and generating current at a periodicity of 90 cycles per second. Orders for turbo-generator sets, totalling well over a quarter million horse-power, were entrusted to the British Thomson-Houston Company during the period under review. Among these orders was a repeat order for a 10,000-kilowatt, or 12,500-kilovolt-ampère, set running at 3000 revolutions per minute. Other machines running at the same speed were also built, whilst a large number of machines, designed for capacities of from 10,000 to 20,000 kilowatts and running at 1500 revolutions per minute, are in the course of manufacture. Amongst these sets is a 20,000-kilowatt machine for the London Electric Supply Company's station at Deptford Although the majority of orders received were for high-pressure turbo-alternators, the company is also building direct-current geared sets, and mixed-pressure turbo sets, mainly for use at collieries. An interesting small power plant recently ordered consists of a 350 horse-power turbine running at a speed of 6000 revolutions per minute. The turbine is to drive a mill by means of a geared chain drive and a slow-speed alternator directly coupled to the slow-speed shaft. Some interesting double-frequency alternators are being constructed in the works of Brown-Boveri, Limited. These machines can either give single-phase 16⅔-cycle current for traction purposes, or 50-cycle current for the general distribution system. The rating in the former case is 7000 kilovolt-ampères at 4000 volts, and in the latter case 6000 kilovolt-ampères at 7000 volts. Each of these sets is to be directly coupled to a 7650 horse-power water turbine.

A distinctly novel steam turbine set was put into service by Brown, Boveri and Co. It is a high-speed geared turbo set, rated at 1340 kilowatts. The speed of the turbine is 7500 revolutions per minute, and that of the alternator 1500 revolutions per minute. By adopting this high speed for the turbine the best possible blade efficiency is secured without detriment to the discharge losses of the last blades. Up to a point the action principle is adopted, but as soon as the height of the blades makes it possible to employ reaction blading this type of blading is used. The reaction blading is constructed on special lines, the distinguishing feature being great simplicity. Their form of blading, the makers explain, affords safe operation, and there are no diaphragms or packings. The high-speed turbine has a high efficiency, whilst the geared generator can also be designed to give the best all-round results. Special types of gears have been designed by Brown, Boveri and Co. for use with these sets. Three turbo-generator sets, each rated at 10,000 kilowatts, were built by this firm for the Edinburgh Corporation, and a 35,000-kilowatt set was ordered by a French firm.

The Metropolitan-Vickers Electrical Company reports that the business done in turbo-generators showed a marked improvement over that of the preceding year, the relative proportions of home and export business being approximately the same as in previous years. The export orders included two 25,000-kilowatt and also one 12,500-kilowatt machine for Japan. The company made several alterations in the designs of its machines with a view to improving efficiency and the construction of parts. For the Birmingham Corporation the General Electric Company is building three 22,500-kilovolt turbo-alternator sets and high-tension switchgear for the main station and sub-stations. For the extensions to the Blackpool Corporation's power station, the General Electric Company is also building a 6000-kilowatt machine, and is making two 3000 revolutions per minute sets, with a total output of nearly 30,000 kilowatts for Australia. Alternators and induction motors were also supplied to Australia by Bruce Peebles, Limited.

**Converting Plant.**

The rotary converter is still the most commonly used form of converter, and its popularity is attributable to its high efficiency and low initial cost, as compared with the motor generator. Some very large machines were built by the Metropolitan-Vickers Electrical Company during the past year for the New South Wales Government railways. These machines are rated at 4500 kilowatts at a pressure of 1500 volts, and are fitted with the makers' self-synchronising starting motors, and are controlled by automatic starting apparatus operated by a simple master switch. Another rotary converter order received by this firm was from the Great Indian Peninsula Railway, and was for eight 1250-kilowatt, 50-period machines, two being connected in series to give 1500 volts. Other firms also report good business in their rotary converter departments. The General Electric Company built several 2000-kilowatt machines and a 1000-kilowatt converter for the Blackpool Corporation. Brown, Boveri set to work during the year "short-circuit proof" units with a normal rating of 750 kilowatts and capable of developing 1250 kilowatts for 2 hours and 2250 kilowatts for 5 min. at a pressure of 1500 volts, The Midi Railway machines, which are of this type, were guaranteed to withstand five consecutive direct short circuits at full voltage without flashing over, but on test they were subjected to no fewer than twenty short circuits, at intervals of 60 sec. without giving rise to trouble. Bruce Peebles and Co. again report satisfactory motor converter business, and some of the machines constructed during the year had large outputs. Five 2000-kilowatt Peebles La Cour motor converters and a 2500-kilovolt-ampère frequency changer were built for Japan. Two 220-kilowatt synchronous motor generator sets, together with other electrical plant, were also supplied to New Zealand. The British Thomson-Houston Company appears to have received a very fair share of the rotary converter business. Last year it was mentioned that great advances had been made in the direction of obtaining larger outputs at given speeds. During the past year, nine 1500-kilowatt, 25-cycle, 500-revolution machines were supplied to Glasgow, and although the output per pole is very high, these machines have proved quite successful. For the Southern Railway the British Thomson-Houston Company is building fifteen 1500-kilowatt, 25-cycle converters. A 4500-kilowatt, 25-cycle, six-phase B.T.H. rotary converter is being supplied to the New South Wales Government Railways. Perhaps the most noteworthy contract secured by the company, however, was for the automatic sub-station contract for the London Electric Railway Company. This sub-station is the first of its kind in this country—or, at any rate, the first automatic sub-station—to be put down for traction purposes. The plant, which has now been manufactured, consists of two 1200-kilowatt, 33⅓-cycle rotary converters with transformers, and control gear will start and stop the machines and protect them against damage under abnormal conditions, and the sub-station will work entirely without attendance. Three automatic sub-station equipments have also been built by the British Thomson-Houston Company for the Manchester Corporation, and they are about to be put into operation. Two automatic rotary converter equipments were supplied to the Liverpool Corporation by the Metropolitan-Vickers Electrical Company, which also built similar equipments for the Barrow-in-Furness Corporation, the Durban Corporation, South Africa, and the Wellington City Council; whilst other automatic equipments are now in hand for the Manchester Corporation, for Ceylon and Sydney. Brown, Boveri and Co. also did a considerable amount of automatic rotary converter sub-station work.

**Mercury Vapour Rectifiers.**

A notable development during the year was an increased demand for mercury arc rectifiers for large outputs. The mercury vapour rectifier has overcome the difficulties that have hitherto existed in connection with the conversion of 50-period three-phase current into high-pressure direct-current. A considerable number of these rectifiers are being built by Brown, Boveri and Co. for the Midi Railway of France. Recent tests that have been carried out in the makers' works have shown that the direct-current pressure can be raised to 5000 volts and over without risk of trouble, the loading on a single cylinder being 1500 kilowatts, which corresponds to a current of 300 ampères. Every five minutes the load was raised momentarily to 2250 kilowatts on a single cylinder representing a current of 480, with perfectly satisfactory results. Indeed, it is said that the voltage and output were only limited by the capacity of the testing plant and not by the rectifier itself. Besides continuous load tests with 5000 volts, short circuit tests were also carried out without any signs of trouble.

**Switchgear.**

All the large electrical firms report good switchgear business. An 11,000-volt switchboard was built at the British Thomson-Houston Company's works for the London Electric Supply Company's new three-phase plant at Deptford. Thirteen additional sub-station equipments were built by the same firm for the electrification of the Brighton section of the Southern Railways, and for five 20,000-volt sub-stations for the Metropolitan Electric Supply Company. During the year this firm also completed the switchgear for the new Barton power-house of the

Manchester Corporation, and the outdoor switchgear for the High-street sub-station at Manchester. For New Zealand several 110,000-volt sub-station equipments are in hand, and a large quantity of 66,000-volt gear is on order for Newfoundland. The Metropolitan Vickers Electrical Company supplied a large number of circuit breakers for use on circuits up to 115,000 volts and with breaking capacities up to 1,500,000 kilovolt-ampères, both for indoor and outdoor service. A new line of armour-clad switchgear for power-station use and with breaking capacities up to 1,500,000 kilovolt-ampères was developed at the Trafford Park works, and switchboards built in accordance with the new designs are in the course of construction. The company did good business with its truck type switchgear which was improved upon, and the range of sizes was extended. New flame-proof switchgear was introduced for colliery use. Also a new line of inexpensive ironclad switchgear, which is supplied in the form of single pillars, motor starters, or complete distribution boards. The circuit breakers are fully automatic, and provision is made for isolation of each circuit breaker by the inclusion of a mechanically interlocked isolating switch. New types of motor control gear were also developed by the Metropolitan-Vickers Electrical Company. A complete set of switchgear for the main station and sub-stations of the Birmingham Corporation was supplied by the General Electric Company. Orders for switchgear for use in connection with new schemes were also received by this firm from the borough of Morecambe, the Southern Railways, the Sunderland Corporation, the South Indian Railway, the Ilford Urban District Council, the Wolverhampton Corporation, the Victoria Falls and Transvaal Power Company, the Grays Urban District Council, the London, Midland and Scottish Railway, and the Newport Corporation, &c. A particularly interesting switchgear scheme was completed during the past year for the Gorseinon Electric Light Company's undertaking. A bulk supply is taken at 33,000-volts and distributed at 3300 and 440 volts, and the whole of the switchgear associated with the supply and distribution was built by the General Electric Company. A special 1800-volt high-capacity switch was developed by Brown, Boveri and Co. for use with mercury vapour rectifiers, and with the aid of this switch a short-circuit current of 8700 ampères has been disconnected in .019 second.

### Electric Railway Equipment.

One of the most important electric traction contracts of the year was awarded to the English Electric Company. For the electrification of the South-Eastern division of the South-Eastern and Chatham division of the Southern Railway, comprising the electrical operation of the suburban service within 15 miles radius of Charing Cross, this firm is supplying 508 traction motors, each rated at 300 horse-power. The contract for the control gear, compressors, and heating and lighting equipments for 124 three-coach motor-driven trains and 59 two-coach trailer units on this line, was awarded to the Metropolitan-Vickers Electrical Company. Another important contract secured by the English Electric Company was for the electrification of a portion of the Campos de Jardao Railway in Brazil. This contract covers the electrification of an existing metre gauge railway, and includes the supply and erection of about 30 miles of overhead catenary construction working on the 1500-volt direct-current system and some 15 miles of 30,000-volt three-phase transmission line. The contract also includes the building and equipment of a sub-station and motor coaches for passenger and goods service. A batch of twenty electric locomotives, built by the Metropolitan-Vickers Electrical Company for the Metropolitan Railway, were put into service, and the work associated with this firm's contract for the London Electric Railway Company is well advanced. This contract comprises the supply of complete equipments for 87 motor coaches and 124 trailer coaches. The excellent results obtained with a new type of Brown-Boveri electric locomotive, with an individual axle drive—which we shall describe in an early issue—have induced the Swiss railway authorities to place an order for more locomotives of this type. A new Brown-Boveri 16,000-volt locomotive oil switch was also developed during the year and it has been adopted as a standard switch for the Swiss railway locomotives.

### Electricity in Mines.

The special winding plant described in our series of articles on Electricity in Mines, and constructed by the Metropolitan-Vickers Electrical Company for the Haworth Main Collieries, was completed during the past twelve months. This plant, it will perhaps be remembered, was designed on a novel principle. It consists of two 1200 horse-power winding motors, each having a maximum capacity of 6000 horse-power and a high-pressure turbine geared to two direct-current generators and a 22-ton fly-wheel. The novel feature is that the speed of the turbine and fly-wheel can vary to the extent of 15 per cent., and the fly-wheel is, therefore, able to provide the extra energy during the accelerating period of the wind, whilst during the retardation period energy can be stored, and since the turbine runs with a uniform steam input the boilers work at a practically uniform rate. By the adoption of this so-called "8 P" system of winding very material reductions in the capital outlay and working expenses are secured, quite apart from the advantages that are derived from electric winding. During the year orders for electric winders were placed with the Metropolitan-Vickers Electrical Company, in sizes ranging from 60 to 1600 horse-power, for collieries in this country and abroad. Brown, Boveri and Co. constructed some large winding plants, including a plant with a Koepe pulley and a direct-current motor working on the Ward-Leonard system. The winding motor has an output of 1600 horse-power at a speed of 44 revolutions per minute, and is directly coupled to the Koepe pulley. An order was also secured by Brown, Boveri and Co. for a tower winder, *i.e.*, a winder placed directly at the entrance of the pit; and driven on both sides by a direct-current motor of the overhung type, running at 47 revolutions per minute. The General Electric Company did a very fair amount of colliery work during the past twelve months. A few weeks ago the power-house at the Whitewood Collieries, Normanton, was opened, and a General Electric turbo-alternator and other electrical plant was put into operation. At another colliery not far distant another power-house will shortly be set to work, and in this case the whole of the electrical plant, both above and below ground, was built and installed by the General Electric Company. The British Thomson-Houston Company is supplying to the Bolsover Colliery Company two very large electric winders which are to work on the Ward Leonard principle, the continuous rating of the motors being 1500 horse-power.

### Rolling Mills.

A very fair number of orders was secured for electrical equipment for the operation of rolling mills. For operating a large rolling mill in the works of Alfred Hickman and Co., of Bilston, the Metropolitan-Vickers Electrical Company is supplying a reversing motor with a maximum output of 11,500 horse-power at a speed of 60 revolutions per minute. It is to drive 18in. rolls which are to be used for making 18in. girders and 15in. channels, &c. A 2000 horse-power motor is also being built by the firm for driving sheet mills. It has a high-speed fly-wheel mounted on its shaft. The most important order recently secured by the Metropolitan-Vickers Electrical Company was from Stewarts and Lloyds, Limited, for a 25,000 horse-power reversing mill motor, which is to drive a 34in. universal plate mill. A very important contract was secured by the English Electric Company. It is for the complete electrification of the new steel works and plate mills of the Consett Iron Company, and English Electric plant, with an aggregate capacity of 54,000 horse-power, is to be installed. There is to be a 40in. slabbing mill, a 42in. plate mill, a 32in. light plate mill, and a chequer plate mill. The first two mills will be of the two-high reversing type, and will be driven on the Ilgner system. Each mill equipment will comprise a double-armature direct-current motor of 14,000 horse-power, and the two Ilgner sets will be driven by 25,000 horse-power motors and will have 48-ton fly-wheels. The light plate mill and chequer plate mill are to be driven by induction motors of 2500 and 750 horse-power respectively. The contract also includes the supply of 220 heavy mill type motors, ranging from 10 to 100 horse-power, for driving various auxiliaries, two 3000-kilowatt turbo-alternators, and two 1500-kilowatt rotary converters, and the transformer equipment. Brown, Boveri supplied the electrical equipment for a large rolling mill in Belgium. The peak load at the coupling of the mill motor amounts to 18,000 horse-power, the speed being 60 revolutions per minute. The machine works on the Ward-Leonard principle. Another rolling mill, with Scherbius regulation, was also put into operation, the motor in this case being a 1200 horse-power 5000-volt, 50-cycle machine. A 2000 horse-power Scherbius motor is also in the course of construction, and also two rolling mill equipments regulated on the Kramer system. The British Thomson-Houston Company's rolling mill orders include one for the conversion of two existing steam-driven hoop mills to the electric drive and for the electrical equipment of a rod mill, the power for these mills being derived from direct-current motors fed from rotary converters.

### Motors.

There has long been a need for an alternating-current motor which will not have a detrimental effect upon the power factor of central stations, and since the introduction of the auto-synchronous machine, motors of this type have been sold in considerable numbers. Crompton and Co., Limited, of Chelmsford, report good business in this connection. Motors of this type were supplied by this firm for use in connection with a cable tramway system. Two Crompton auto-synchronous slow-speed motors were built with rotors of 132in. in diameter. The firm also supplied the complete electrical equipment for the new Southampton 60,000-ton floating dock, and a number of three-phase auto-synchronous motors for driving refrigerating compressors at the largest ice factory in Europe. Among the contracts received for 1924 is one for a large number of motors for driving a paper mill in Newfoundland, some of these machines being synchronous motors of 2600 horse-power. These machines are to run at a speed of 232 revolutions per minute and with a leading power factor of .67. An order was also received for the electrical equipment of one of the largest sugar mills in Australia. The Metropolitan-Vickers Electrical Company also experienced good business in connection with synchronous induction motors. High-speed machines were supplied to run at leading power factors. Two machines built by this firm are rated at 450 and 500 horse-power, and run at 1500 revolutions per minute, with .8 to .9 leading power factor. The paper-making and printing industries are rapidly changing over to the electric drive, and the British Thomson-Houston Company's variable speed alternating-current commutator motors have proved very successful for this class of work. One of the most recent orders is for an automatic push-button controlled paper calendar equipment, the motor being a three-phase commutator machine giving a speed variation of 3 to 1, and rated at 150 horse-power at top speed. In another mill the British Thomson-Houston motors installed aggregate over 2300 horse-power. A large number of this firm's salient pole synchronous motors were supplied during the year, including two 1125 horse-power machines for driving reciprocating air compressors working on the Powell Duffryn Company's system.

### Wireless Communication.

Senatore Marconi's experiments, carried out during the year in connection with communication over long distances with short waves radiated in the form of a beam, were of very great interest. Instead of the radiated energy being dispersed over 360 deg. it is concentrated in a narrow beam, and the power required for communication over a given distance is reduced. The system also leads to increased privacy. The experiments were carried out between the Marconi station at Poldhu in Cornwall and Senatore Marconi's yacht Electra, in the neighbourhood of Cape Verde Islands, are expected to lead to some very important results, for when working with only 1 kilowatt and with a wave length of 100 m., Senatore Marconi was able to maintain effective communication over a distance of 2250 miles. The short wave revolving beam transmitter at Inchkeith Island, in the Firth of Forth, operated very satisfactorily during the year, and another installation of the same kind, but designed for a greater range, is being built at South Foreland. During the year the use of direction finders on board ship increased very considerably, and they proved a great aid to safe navigation. There was steady progress in the use of wireless equipment on passenger vessels. The employment of valve transmitters was extended and the range of communication was greatly increased. High-speed automatic transmitting and receiving apparatus installed on the North Atlantic vessels has enabled traffic to be cleared much more expeditiously than it was originally. On the American side the two wireless stations at Louisberg and Chatham have been designed to handle high-speed messages from ships, and on the European side this is done at the station at Devizes. A good deal of attention was paid during the year to the problem of equipping lifeboats with wireless apparatus. About twenty lifeboats were fitted with wireless apparatus, and it is anticipated that many others will be equipped during 1924. A new lifeboat set with direction finding gear was developed by the Marconi Company. Needless to say, there was also considerable progress in connection with broadcasting. One of the most important developments was the introduction of the magneto microphone, which greatly improved the quality of the transmissions. Every flying machine on the regular commercial aircraft routes is now either fitted or is about to be fitted with wireless telephone equipment, whilst aerodromes have been equipped and organised to carry out direction finding for these services. Military aircraft equipments were designed for enabling small fighting machines to communicate with the ground and also with one another. Wireless telephony is also being employed for communication between lifeships and their shore bases. The application of wireless telephony to moving vehicles was another new development. The authorities at Scotland Yard have already adopted this system, and there is no doubt that military and other people will employ it in due course. The establishment of an imperial wireless system of communication received consideration during the year by the Government and by the Imperial Conference. The Government is now building a high power station at Rugby, and there is every indication that licences will shortly be granted to the Marconi Company to build other stations to communicate with the Dominions. High-power stations are already under consideration in Australia and South Africa, whilst licences have been granted for the erection of high-power stations in Canada, and other stations are contemplated in India. A good deal of interest was displayed during the year in the working of the Marconi station at Ongar in Essex, which operates in conjunction with the Central Telegraph Office at Radio House in the city. In June a party of members of Parliament visited these stations and were very much impressed with the method of working.

Early in the year the Western Electric Company

gave a Transatlantic wireless telephony demonstration. Speech was successfully transmitted from 195, Broadway, New York, to New Southgate, and during the past twelve months experiments were made every day with a view to discovering how much power would be required to maintain a commercial system of wireless telephony across the Atlantic. The British Broadcasting Company has also just shown that under favourable conditions it is possible to receive and re-transmit the transmissions of the low-power American broadcasting stations. To meet the rapidly increasing demand for wireless receiving apparatus the British Thomson-Houston Company opened a new factory at Coventry, close to the company's magneto factory. Several new types of receivers were placed upon the market, also head telephones and loud speakers, and a new dull emitter valve which only consumes .06 ampère.

## Aeronautics in 1923.

No. I.

AERONAUTICS, scientifically and industrially, continued, in the past year, to derive its inspiration and sustenance principally, if not entirely, from military requirements. The transport of passengers and goods by aeroplane has so far not reached the stage, or anything like it, which, in the opinion of some, it should have done, and which, at the beginning of May, 1919, when civil aviation was first permitted in this country, it seemed to many to contain the promise of reaching.

### Civil Aviation.

So far as the development of the commercial side of aviation in the past year was concerned, it is, no doubt, true that the position was rendered difficult by other than purely technical factors. In January the three companies operating the cross-Channel services found themselves placed in much uncertainty by the appointment of a Civil Air Transport Subsidies Committee, which was set up by the Air Minister to consider the working of the existing scheme of air transport subsidisation and to advise how the subsidising should be continued in the future. That Committee, in its report, recommended that when the existing scheme came to an end on March 31st this year, Government assistance should be withdrawn from the established air transport companies as such and given to an entirely new company to be formed with a capital of a million sterling, the subsidy amounting to a like figure spread over a period of ten years. While the Committee was sympathetic towards the established companies, it very expressly recommended that the new company should not be formed by a mere amalgamation of the Handley Page, Instone and Daimler air transport undertakings. Invitations were accordingly issued by the Air Ministry to those likely to be interested in the formation of the proposed "Imperial Air Transport Company," and in the event an agreement was entered into towards the end of the year by the Government and the British, Foreign and Colonial Corporation, Limited, for the establishment of such a company. As soon as the new company has been satisfactorily floated and the shares allotted, Sir Herbert Hambling, deputy chairman of Barclay's Bank and Chairman of the Civil Air Transport Subsidies Committee, and Major J. W. Hills, at one time Financial Secretary to the Treasury, will join the board of directors as Government representatives. It is understood that representatives of the established companies, together with Sir Eric Geddes and Lord Invernairn, will be invited to join the board; but even so it is obvious that the withdrawal of Government assistance from these companies and the subsidisation of an entirely new undertaking could not be proposed and cannot be carried out without involving a period of transition during which the natural development of civil aviation must suffer.

While the established continental air services languished—or, at the best, remained stationary—under the influence of the Hambling Committee's projected scheme, some mail-carrying experiments, conducted on behalf of the Government by the de Havilland Aircraft Company during September, gave considerable promise of a new and useful field for the commercial employment of aeroplanes in Great Britain. The experiments consisted of picking up mail bags at Plymouth, in connection with the arrival of the Atlantic liners, and their transport to Belfast by way of Birmingham and Manchester. They were continued over a period of a month, and are understood to have afforded satisfaction to the air and postal authorities and to have shown not only that the scheme was practicable, but that it was capable of being extended so as to permit mails for Scotland to be dropped at Carlisle or Stranraer.

In September, too, a new regular air service was opened by the British Marine Air Navigation Company, with a daily trip in both directions between Southampton and the Channel Islands. This service is of particular interest, in that it employs flying boats—of the Supermarine Sea Eagle type—as distinct from the land aeroplanes of the companies operating from Croydon. It is understood that under the Imperial Air Transport Company's control, this service, like those to the Continent, will be considerably extended, and that eventually connections by air will be provided between Southampton and Cherbourg, and between Croydon and Zurich, Berlin, and even Constantinople.

### Light Aeroplanes.

Following the successes achieved in 1922 with gliders, or wind-flight machines, the past year witnessed the rise of a new class of aeroplane—a light glider type, fitted with a small petrol engine serving largely as an auxiliary to the machine as a glider. Interest in this new class was brought to a head in a series of competitions held at Lympne in October. Twenty-eight machines were entered for the contests, in connection with which prizes totalling over £2000 were offered. Although the gathering was marked by a most unfortunate accident, whereby M. Maneyrol, the winner of the 1922 gliding competition at Itford, lost his life on the last day, it successfully demonstrated the wonderful capabilities of the low-powered light aeroplane. Two of the machines succeeded in flying 87.5 miles on a gallon of petrol; another reached a speed of 76.1 miles an hour; a fourth attained a height of 14,400ft., and a fifth flew during the week an aggregate distance of 1000 miles. The successes were such as to encourage the development of the light aeroplane, and this year there is the promise of a competition for machines of this class capable of carrying two people.

### Military Aeronautics.

So far as technical developments on the military side are concerned, it is difficult, or impossible, to obtain any detailed particulars as to the progress made, for the Air Ministry—rightly, no doubt—insists on the preservation of a considerable degree of secrecy as to what is being done. It is known, however, that under the scheme, followed so successfully during the later stages of the war, whereby the aircraft manufacturers are allowed a wide freedom to develop their own ideas, some military machines of a most interesting and progressive type have been produced.

On the orgnisation side two important steps were taken during the year. In the first place, it was decided in June to increase the Royal Air Force to a strength sufficient "adequately to protect us against air attack by the strongest air force within striking distance of this country." To this end the home defence force was to be brought up to a total of fifty-two squadrons, representing probably something like 800 or 1000 machines. In the second place, active steps were taken to increase the country's resources in the way of pilots by the organisation of an "Air Force Reserve of Officers." Ex-officers and others with special qualifications have now been enrolled up to the limit originally planned and are receiving periodic training at four flying schools established in connection with the works of four aeroplane manufacturing firms, namely, at the de Havilland Company's works at Edgware; at the Bristol Aeroplane Company's works, Bristol; at the Armstrong-Whitworth Aircraft Company's works, Coventry; and at William Beardmore and Company's works near Glasgow. Two hundred additional ex-pilots and others are now required for the reserve and two more flying schools are to be established, one in the North of England and one at Brough, on the Humber, where training in seaplane work will be given.

### Helicopters.

Attention continued to be directed towards the development of the helicopter. In France the Pescara and Oemichen machines, in the United States the de Bothezat machine, and in this country Mr. Louis Brennan's machine, were all reported to have succeeded in executing more or less short flights or hops; but on no occasion was it claimed that any one of them showed signs that its inventor had solved the problem of helicopter flight. The Brennan machine, constructed at the Royal Aircraft Establishment under the auspices of the Government and largely at the public expense, has been under trial for a long time past, but it is difficult to discover what results have been achieved with it. In May the Government announced its intention of awarding prizes totalling £50,000 in a competition for helicopters. The technical requirements to be fulfilled by the successful machines are so obviously impossible of attainment by any machine at present known to be in existence or likely to be constructed before the closing date, April 30th next, that the opinion is commonly held that the Government does not mean the competition to be taken very seriously. In the United States we have seen much the same course followed. After lengthy experimental work with a form of helicopter, the Army and Navy aeronautical authorities have announced that the machine will for the future be exhibited in a museum and that they intend to offer £50,000 in prizes for privately designed and constructed helicopters.

### Airships.

In this country the Burney scheme for the establishment with Government assistance of a regular airship service between England and India *vid* Egypt, with a possible subsequent extension to Australia, still awaits official final approval, although in the opinion of the Air Minister there is no reason why the agreement should not be completed. During July the scheme was taken a step farther towards realisation by a proposal to form a company with a capital of £400,000 to operate it. Vickers Limited and the Shell Oil Company were mentioned as likely to accord the company financial assistance. Excepting this scheme, nothing was done in this country during the year to advance the development or application of the airship. Abroad the most notable event in this branch of aeronautics was probably the prolonged flight of the Dixmude, a Zeppelin airship surrendered to France under the terms of the Peace Treaty. Leaving Toulon on September 25th, this vessel crossed the Mediterranean, flew along the African coast and proceeded far inland before returning. It alighted again at Toulon on the 30th, after having been in the air for 118 hours 41 minutes and travelling some 4400 miles without a stop. On December 18th the vessel again left Toulon for a similar trip with sufficient fuel on board for a five-day continuous flight. Very bad weather was encountered, and on the 22nd a wireless message was received from her, stating that with her fuel exhausted she was drifting helplessly eastward. From that date no further authentic news of the vessel was received, and it has now been established beyond all doubt that yet another airship disaster—in this case involving the loss of fifty lives—must be added to the already lengthy list.

THE BRISTOL "LUCIFER" DUAL CONTROL MACHINE

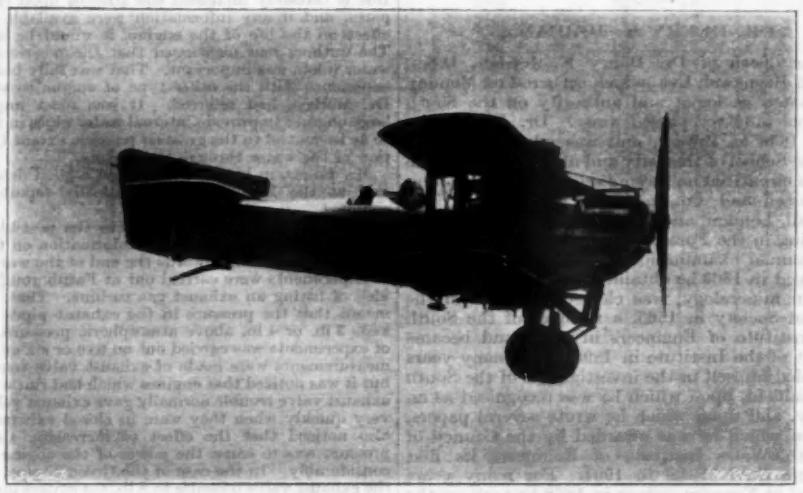
In the construction of airships the most notable event of the year was the building at Friedrichshaven of the passenger and mail-carrying Zeppelin LZ 126. This vessel was described and illustrated in our issue of December 7th, and when completed and tested is to be flown across the Atlantic and handed over to the American Government under the terms of the Peace Treaty. She has an overall length of about 656ft., a maximum diameter of about 91ft., and a gas capacity of some two and a-half million cubic feet. She is designed to accommodate twenty passengers and a complement of five officers and a crew of twelve. With five 400 horse-power Maybach engines her designed normal service speed is in the neighbourhood of 68 miles an hour. It is of interest to note that an American company—the Goodyear Tyre and Rubber Company—has purchased all the patents and rights relating to the manufacture of Zeppelin airships, and that the town of Akron, Ohio, will now presumably become the chief centre of the Zeppelin building industry.

### Some Typical British Aeroplanes.

We give below some notes on the work of the

principal British aeroplane manufacturing firms. As we have said, much of that work was carried out for the Air Ministry, and concerning it little or nothing may be said. It cannot therefore be pretended that our review of the year's construction is either complete or up to date. Nevertheless, the information available is, we think, sufficient to show that in the design of aircraft British firms are still, in spite of the adversity of the times, producing machines of a very high class and of considerable originality.

*Boulton and Paul.*—The Boulton "Bodmin" P.12, built to Air Ministry specification for use as a postal machine or for military purposes, was completed ready for flight during 1923. The machine—illustrated in the Supplement—carries a crew of three and is constructed throughout of metal. Its special feature is a central engine-room, housing two Napier "Lion" engines. This arrangement, it is claimed, gives a balanced thrust for all conditions of engine running, and also provides means of access to the power unit in flight, a very essential feature for postal work over desert country. The power unit is so arranged that the forward engine drives through shafting and bevel gearing to port and starboard two-bladed tractor air-screws in front of the wings, while the rear engine drives in a similar manner two four-bladed propellers aft of the wings. The engine mounting is supported on top of the fuselage so as to leave the whole of the space below as a passage connecting the open spaces provided at each end of the engines. In the centre of the fuselage between the two engines is the engineer's station, and all pressure gauges, thermometers, petrol controls, &c., are concentrated at this point to give the engineer full engine control during flight. The radiators are made up of two units, one on each side of the fuselage, and are supported on the engine torque shaft casing. Streamline fairing tail pieces are fitted to each unit, thus



THE FAIREY "FAWN" MILITARY MACHINE

reducing the drag when the radiator shutters are closed. Each radiator unit is made up of three interchangeable elements, and by a system of centralising boxes any one element can be cut out of the system at will. Should an element spring a leak in flight the affected section can be cut out, thus preventing a forced landing as a result of loss of cooling water. The petrol pipe line arrangement is such that the engine supply may be selected from any one of four main petrol tanks carried on a structure between the front and rear air screws. This position for the fuel tanks, in addition to reducing fire risk, is claimed to be particularly good from the resistance point of view. The general structure of the machine is built up upon the method of utilisation of high tensile steel, &c., as developed by the firm, all the sections used being formed at the Norwich works by a special plant. The undercarriage has two main wheels and two forward wheels. The shock absorber is of the oleo pneumatic pattern. The machine has a length of 53ft. 4½in. and a span of 70ft. The area of the main planes is 1350 square feet. Its weight empty is 7920 lb. In addition to the crew it can carry a useful load of 560 lb. Its speed at ground level is 116 miles per hour and at 10,000ft. 112 miles per hour.

In addition to the completion of the "Bodmin" another machine has been designed to Air Ministry specification, built and flown, and has proved, we learn, highly satisfactory. At the present moment the firm has a number of these machines in production, but is not in a position to give any details concerning the design. It is proceeding with its researches into the use of metal in aircraft construction, and also in connection with anti-corrosion treatments.

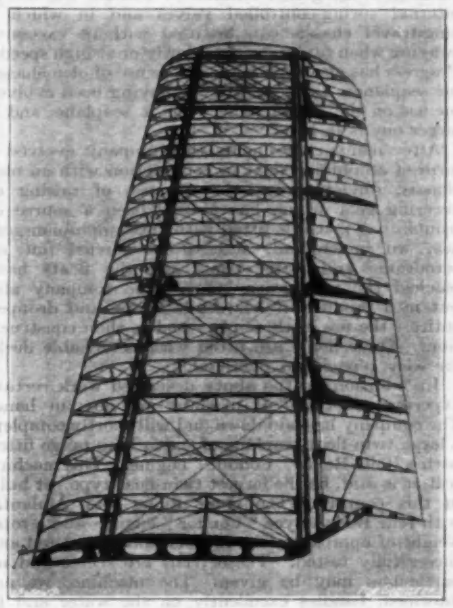
*Sir W. G. Armstrong Whitworth Aircraft, Limited.*—The Coventry works of this firm have completed and delivered to the British Government some troop-carrying aeroplanes of a type called the "Awana." These aeroplanes—of which an illustration is given in the Supplement—are fitted with two 450 horse-power water-cooled engines, and have a total loaded weight of about 8 tons. The firm has also completed a number of single-seater aeroplanes of the "Siskin" type. The framework of these aeroplanes is constructed entirely of steel, and it is believed that the "Siskin" is the first type of steel aeroplane which has been put into production in this country. With regard to the photograph of the "Siskin"—reproduced in the Supplement—it is to be noted that it represents an earlier type, photographs of the latest form not being available for publication. The firm has also produced a two-seater aeroplane known as the "Wolf," but here again it is not permissible to publish photographs or a description of the machine. The "Wolf" and "Siskin" aeroplanes are fitted with the "Jaguar" air-cooled radial engines made by the associated company, Armstrong Siddeley Motors, Limited. Of this engine a number were delivered during the year to the British Air Ministry and to several countries abroad. Armstrong Siddeley Motors, Limited, in addition, made a number of seven-cylinder engines of a type known as the "Lynx," which is practically half the "Jaguar" engine. These engines have been and are being used principally for training aeroplanes. In addition to the above work a training school, as mentioned above, was started at the company's aerodrome at Whitley, near Coventry. This school is primarily intended for the training of reserve officers of the Royal Air Force, and is used in addition as a testing ground for all aeroplanes built to contract. It is interesting to note that the principal race of the year, namely, the 800 mile circuit of Britain for a cup given by his Majesty the King, was won by an Armstrong Whitworth "Siskin" aeroplane fitted with an Armstrong Siddeley "Jaguar" engine. This aeroplane made both the fastest time and arrived first on handicap.

*The Bristol Aeroplane Company, Limited.*—The Bristol Aeroplane Company, Limited, continued a steady programme of development work during the year, both in regard to aircraft and air-cooled aero engines. Unfortunately, much of its work is of a confidential character, and cannot be discussed in this review. Details, however, are available of two new types of aircraft. The first of these is an improved machine of the "Bristol" fighter type, of which an illustration appears in the Supplement. Fitted with various water-cooled engines, the "Bristol" fighter is the standard two-seater fighter used by the Royal Air Force and in many other countries. It has now been fitted with a 400 horse-power "Bristol" Jupiter radial air-cooled engine, and as a result its general characteristics, manœuvrability and fighting qualities have, we learn, been greatly improved. It has now a speed of 129 miles an hour at 10,000ft., and a service ceiling of 22,500ft., and can climb to 10,000ft. in 8¼ min. One of these machines was flown by Captain Macmillan from Croydon to Gothenburg in one day in 7¼ hours flying time.

The second type of new aeroplane is the "Bristol" Lucifer school machine, of which an illustration is given herewith. This aeroplane was especially designed and developed to afford a means of training with a really modern machine fitted with a modern type engine, namely, the 100 horse-power "Bristol" Lucifer radial air-cooled aero engine. It is the standard school machine in use at the Bristol Flying School for Reserve Officers, and has, we are informed, proved excellent for its purpose. The machine is a single-engined tractor-biplane with dual control. Petrol is supplied from a tank fixed in front of the pilot and is fed by gravity through a large and readily removable filter. A steel fireproof bulkhead is fitted behind the engine, and all control connections pass through it in fireproof glands. The carburetter intakes are carried through the bottom side of the engine cowling, thus eliminating any possibility of an accumulation of petrol. The upper and lower wings are identical and interchangeable, and are of the single bay type. The interplane struts are of "N" formation, and require no trueing up. An oleo-steel spring-type chassis is fitted, which not only increases the comfort of the passengers when landing or taxi-ing on rough ground, but tends greatly to lengthen the life of the machine by minimising wear and tear. The tail incidence can be varied by a lever and quadrant adjacent to the pilot to trim the machine under all conditions of speed and load distribution. The machine has a span of 31ft. and weighs, empty, 1210 lb. At ground level, when fully loaded, it has a speed of 90 miles per hour, and it can climb to 1000ft., fully loaded, in 2 min. It carries 25 gallons of petrol, sufficient for a flight at cruising speed of 5 hours.

A large amount of important experimental work was undertaken in the company's engine department. The latest type of the 400 horse-power Jupiter engine—Mark IV.—incorporates many features designed to increase the reliability. This type of engine, during the year, created records in France for altitude—in a Spad Berline biplane—and for speed—in a Gourdou-Lesseure monoplane. The 100 horse-power "Bristol" Lucifer engine has also been improved, the latest design being fitted with a hand-starter with half-compression device, exhaust ring silencer, carburetter air intake heater, &c. The Bristol Aeroplane Company, Limited, is the only firm of aero engine manufacturers which has developed a small engine for use with the new types of light aircraft. The "Bristol" Cherub engine is a twin-cylinder horizontally opposed engine of 1096 c.cm., and is made either as a direct drive or geared unit. The first form weighs about 75 lb. and delivers up to about 35 horse-power.

*The Fairey Aviation Company, Limited.*—The



FAIREY ALL-STEEL WING FRAME

Fairey Aviation Company, Limited, of Hayes, Middlesex, now employs over 1000 hands, and in addition to some large contracts in hand for the British Government, it is also working on contracts for Japan, Sweden, Australia and Portugal. The works were largely reorganised during the year, and much additional plant laid down, while the drawing-office, inspection and commercial staffs have been more than doubled. This increase is largely due, the firm tells us, to the success of the new types brought out early in the spring, both of which have been adopted by the Government, and for which large orders have been placed.

The company produced two new types during the year, and both are in production for the Royal Air Force, so that in addition to experimental work the company has now three designs in full production, comprising one aeroplane, one deck amphibian and one seaplane.

The "Fawn" is a new type of reconnaissance and bombing aeroplane built for the Air Ministry. A view of it in flight is given herewith. It was the winner of an Air Ministry Design Competition, and has passed its trials and is now in quantity production. No particulars may be given, but the special features of the machine, apart from its high performance and lifting capacity, are the arrangements made for landing in rough country. It has a special form of oleo pneumatic chassis of great shock absorbing power, and is made for easy manœuvrability on the ground for turning in small fields.

The "Flycatcher"—of which a photograph is reproduced in the Supplement—is a special type of fighting deck aeroplane. This machine passed its trials in March last, and is also in full production for the Air Ministry. The type is intended for naval co-operation and for launching from the decks of all classes of ships. It is built either with an oleo

land undercarriage of similar construction to that of the "Fawn," or with a special type of amphibian gear. No particulars of speed, dimensions, &c., may be given. The machine is built on a special form of construction in which steel tubing is largely used without any form of welding. The "Flycatcher" was designed as a result of certain research work conducted by the company, and is claimed to be the first machine in use in the Royal Air Force, in which the controls work definitely down to and below the stalling speed, a feature which prevents one of the chief causes of accidents. The machine can, in fact, be landed in the stalled condition without one wing falling and starting a spin.

The Fairey III.D. seaplane is the latest model of the Series III. type which has been in production for many years. It is now fitted with a Napier "Lion" engine and three seats instead of two. Improvements have been made in the floats and landing chassis and in such matters as engine starting, tail adjustment and equipment.

The principal development work undertaken by the firm was the experiments in slow speed and stalled flying from which the "Flycatcher" type was produced. The company proposes to continue these experiments this year with a view to applying the results to a larger type of machine. The company continued its work on steel construction, and the machines are being changed over to metal construction as the components are developed. All-steel wings for the standard III.D. seaplane have been tested with, we understand, very satisfactory results. A view of such a wing is reproduced herewith.

An oleo-pneumatic landing undercarriage was developed and is now being fitted to all the three types of machine in production. After many experiments a type was evolved in which rebound, it is claimed, is altogether eliminated without the use of internal spring-controlled valves and in which a long-travel chassis can be used without excessive swaying when taxi-ing either slowly or at high speeds. Progress has also been made in the use of oleo chassis for seaplanes, a successful type having been evolved for use on the "Flycatcher" as a seaplane, and a larger one is in hand.

After many experiments the company evolved a form of amphibian float in conjunction with an oleo chassis, obviating entirely the use of raising or lowering gear which has always been a source of trouble. A machine fitted with this amphibian gear has, we understand, successfully carried out all aerodrome and water trials and the floats have reached the production stage. The company also put into production boat-built floats, and dropped entirely the use of three-ply wood in their construction. These floats are fitted with detachable decks for easy repair and overhaul.

In addition to the above described work certain experimental types of machine are now in hand. The company has laid down and will shortly complete a large twin-float seaplane of extra long range fitted with a Rolls-Royce "Condor" engine. This machine will, it is said, be the largest twin-float type yet built in this country. The giant flying boat Atalanta, with four Rolls-Royce "Condor" engines and a total weight of approximately 15 tons, was completed and successfully tested. These trials are secret and no particulars may be given. The machine, we are informed, handles excellently on the water and in the air. Another machine of this type has been completed and will be ready for trials shortly.

## Obituary.

### ALEXANDRE GUSTAVE EIFFEL.

THE death of Monsieur Alexandre Gustave Eiffel in Paris last week has occasioned sincere regret amongst engineers beyond the boundaries of his own country, for not only were his achievements, during a particularly long career, remarkable, but his personality secured for him a popularity that ranked him, justly, as one of the leading engineers of his period.

Born at Dijon on December 15th, 1832, Monsieur Eiffel had entered upon his ninety-second year, and, until the last few weeks of his life, he had continued a practical interest in the experimental side of aerodynamics, which he took up at a time when, through advanced age, he relinquished his active participation in structural engineering. For Monsieur Eiffel was essentially a structural engineer. He received his training at the Ecole Centrale, and at the age of twenty-six he designed and constructed a metallic bridge at Bordeaux, introducing novel features that showed already the bent of his mind in the way of employing bold and original methods to overcome special difficulties. During the greater part of his career, Monsieur Eiffel was identified more particularly with bridgework, and his methods were largely responsible for the progress made in France in that branch of engineering. The development of the railways gave him exceptional opportunities, and a large number of bridges were designed and built by Monsieur Eiffel, who was particularly successful with the launching of long single-span bridges across deep valleys. He introduced caissons for the construction of bridge piers.

Monsieur Eiffel also designed works for the de Lesseps Panama Canal, which could not be carried out through the failure of that mismanaged undertaking, and his association with the Panama affair was the one mistake in his long and honourable career. Although he paid the penalty, with others, for being drawn into the Panama speculation, there were few who admitted his responsibility, and his life's work was not tarnished by this incident.

Associated at an early date with an engineering concern in Paris, he continued to carry out important works, and while he designed the Machine Gallery at the Paris Exhibition of 1878, his great achievement was the building of the famous tower bearing his name for the Exhibition of 1889. The boldness of the work was characteristic of Monsieur Eiffel's methods, and although regarded as a temporary structure, it has become so useful for meteorological and wireless purposes that there is, for the time being at any rate, no likelihood of its demolition.

Monsieur Eiffel did little outside structural engineering until he retired about fifteen years ago and devoted his attention to aerodynamics, when he established a laboratory at the Eiffel Tower. From that time onwards he did consistently valuable work, and probably contributed more than any other individual to the knowledge of plane forms based upon experimental tests. He, in fact, prepared the way for a theoretical study of aerodynamics by means of practical demonstrations. His book on "The Resistance of the Air and Aviation," an excellent translation of which by Mr. Jerome C. Hunsaker was published in 1913, is a model of what an account of scientific experimental research should be. He was one of the early Presidents of the Société des Ingénieurs Civils de France, and was present at the meeting in Paris last year of the Institution of Mechanical Engineers, of which he was an honorary member.

### DR. HENRY K. JORDAN.

BY the death of Dr. Henry K. Jordan, D.Sc., F.G.S., of Brynawel, Usk, which occurred on Monday last, a noted geologist and authority on the South Wales coal industry passed away. Dr. Jordan was born in 1838 at Bristol, and was educated at the Cathedral School of that city and also privately. He became apprenticed on leaving school to Messrs. John Scott-Russell and Co., engineers and shipbuilders, of Millwall, London, and was later engaged in mining engineering in the Forest of Dean and South Wales. At the annual examination of the Science and Art Department in 1863 he obtained second place (bronze medal) in mineralogy, was elected a Fellow of the Geological Society in 1865, a member of the South Wales Institute of Engineers in 1873, and became President of the Institute in 1898. For many years he occupied himself in the investigation of the South Wales coalfield, upon which he was recognised as an authority, and upon which he wrote several papers, for one of which he was awarded by the Council of the South Wales Institute of Engineers its first President's Gold Medal in 1904. For many years he resided at Newport, where in 1858 he took up the management of Russell's Forge and Anchor Works. He was a Justice of the Peace for Monmouthshire and a director of the Pontypool Gas and Water Company.

### OSWALD M. PROUSE.

THE death occurred somewhat suddenly at Ilfracombe on December 24th, at the age of sixty-six, of Mr. Oswald M. Prouse, for thirty-two years engineer and suveyor to the Ilfracombe Urban District Council. Mr. Prouse had been in poor health for some time, but he attended his office on the preceding Saturday and had convened a committee meeting for the day on which he died. He was regarded in the West of England as a man of outstanding ability, and in 1903 he carried out, at a cost of £30,000, the Ilfracombe sewerage scheme, and in the following year the Challacombe water supply scheme, which involved an expenditure of £65,000. Before his appointment as the council's engineer and surveyor in 1891, he was on the engineering staff of the London and South-Western Railway, and was in charge of the work when the line between Barnstaple and Ilfracombe was doubled.

## Institution of Mechanical Engineers.

A MEETING of the North-Western Section of the above-named Institution was held at the Engineers' Club, Manchester, on Thursday, December 20th, when the paper on "Exhaust Valve and Cylinder Head Temperatures in High-speed Petrol Engines," by Professor A. H. Gibson, D.Sc., and H. Wright Baker, M.Sc., was presented by Mr. Baker. There was a very satisfactory attendance of members.

After Mr. Baker had given a *résumé* of the paper, Mr. Telford Petrie asked whether the authors had considered the effect of a silencer on the temperature of the exhaust valve. He could not see why the change of position of the plug should affect the results.

Mr. Onions expressed surprise that the authors did not refer to the effect that might be produced by exhaust conditions. The arrangement of the exhaust pipe had a material influence on the whole combustion chamber. He asked the authors what the effect of increasing the lift of the exhaust valve would be. In actual practice the light valves were cooler in operation than heavier valves.

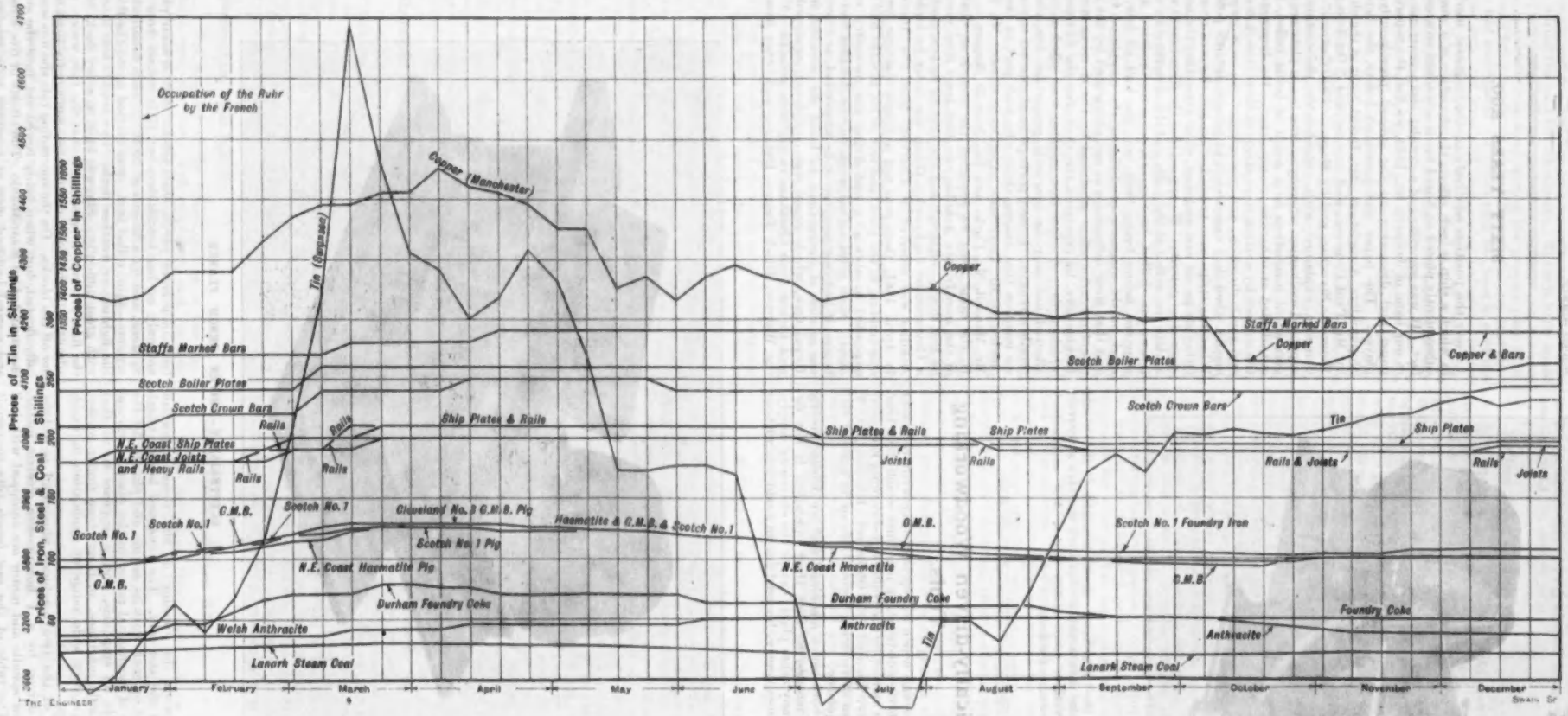
Dr. Morley said that there was a reference in the paper to the fact that, speaking generally and referring to the high-speed engine, the larger the valve the higher was the temperature. One would have expected, and one had originally always expected, that the cooling of the very large valves of the heavy slow-speed engines would present serious difficulties. These valves were up to 15in. to 16in. diameter, and many makers adopted an elaborate system of water cooling. The engines in which he was interested had no water cooling at all actually in the valve or valve stem. The valve was of cast iron, screwed and riveted on to the end of a steel stem, which passed through a water-jacketed valve box, and means were taken to carry the water circulation right round the seat itself, which was removable and of V section, so that the seat was very thoroughly cooled. In the case of that type of engine, a cooling arrangement such as he had mentioned was perfectly successful. It obviated the difficulty of carrying the water into a moving part. In that connection, he would also like to mention that with that engine, until recently, there was a cast iron sleeve forming an extension of the bush through which the valve spindle worked. That sleeve projected as far as was possible towards the head of the valve, the intention being to protect the upper end of the stem from the rush of exhaust gas. There were certain objections to it, and about a year ago it was removed in some engines, and a few weeks ago he learned that no appreciable ill effect had been noticeable on the valve stem. It was pointed out in the paper that the advancement of the spark had many advantages from the point of view of economy. He would like to ask the authors if they had any information as to the effect upon the life of the engine. He found that the operating engineer, the man who was more concerned with having his engine running sweetly and smoothly than with the economy of fuel, did not like a sharp-peaked diagram, and he retarded the spark in order to get a smooth running engine. He quite agreed that, from the point of view of economy and maximum power, the advancement of the spark was right. But it certainly increased the stresses upon the moving parts, and if any information were available as to the effect on the life of the engine, it would be interesting. The authors had mentioned that the position of jacket water inlets was important. That was fully borne out by experience with the other type of engine to which he—Dr. Morley—had referred. It was most important in large engines to provide internal water pipes in the jackets so as to control to the greatest possible extent the circulation of the water through the jackets.

Mr. Baker, in his reply, repeated a good deal that was said at the London meeting already reported in our columns.

Professor Gibson, replying as to the possible effect of a silencer, said they had some information on that point, because at one time towards the end of the war a number of experiments were carried out at Farnborough with the idea of fitting an exhaust gas turbine. That, of course, meant that the pressure in the exhaust pipes had to be kept 3 lb. or 4 lb. above atmospheric pressure. A series of experiments was carried out on five or six engines. No measurements were made of exhaust valve temperatures, but it was noticed that engines which had run without any exhaust valve trouble normally gave exhaust valve trouble very quickly when they were in closed exhaust. It was also noticed that the effect of increasing the exhaust pressure was to cause the power of the engine to fall off considerably. In the case of the Green engine, increasing the exhaust valve pressure to 8 lb. per square inch reduced the power of the engine by over 60 per cent. That was the worst. A silencer, in so far as it increased the exhaust pressure, would affect the exhaust valve temperature adversely. With regard to plug positions, there again they did a very large number of tests on different cylinders to determine the effect. In all these cylinders, three or four alternative plug positions were provided, and the plugs were generally in pairs, diametrically opposite to each other on the cylinder. All the cylinders were fitted with thermo-couples on at least four sides of the cylinder, so that a fairly complete distribution could be obtained. It was found that if they changed over from one plug to the opposite plug, the cylinder temperature on the plug side was the hotter. The effect was very pronounced. The reason was that when running on a central plug, the gas was ignited and the compression and combustion of the remaining gas in the cylinder increased the pressure of the already burnt gas round that plug. To compress already hot gas meant a very considerable rise in temperature, and the temperature of the gas on the plug side of the cylinder was very much hotter than the gas removed from the plug. The hottest part of the cylinder was always that part nearest the sparking plug. He mentioned one other point—the difference between the difficulties in cooling a small valve on a high-speed petrol engine and in cooling a large valve on a slow-speed gas engine. The heat flow per square inch of cylinder surface in such an engine was very much lower than in high-speed petrol engines, probably of the order of one-third. And whereas the temperature of the exhaust gases in such engines as had been mentioned ranged from 900 deg. to 1100 deg. Cent., in a gas engine of 11in. diameter cylinder the exhaust gas temperature was about 650 deg. Cent.

THE WHITWORTH SOCIETY.—The first commemoration dinner of the Whitworth Society was held at the Holborn Restaurant on December 21st, the anniversary of Sir Joseph Whitworth's birthday. Some 100, out of a total of 400, members of the Society took part in a very enjoyable evening, effective and amusing speeches being made by the president, Dr. H. S. Hele-Shaw, F.R.S., and Sir Henry Fowler, K.B.E. The president pointed out that the objects of the Society were neither political nor technical, but to recognise benefits received and to help Whitworth Scholars. The custom of drinking in silence to the memory of the founder was duly observed. It was announced that Mr. R. B. Buckley, C.S.I., who, as far as can be traced, is the oldest living Whitworth Scholar, would act as the next president, and would be inducted into office at a dinner it is hoped to arrange in connection with the World's Power Conference, June 30th to July 12th, at the forthcoming British Empire Exhibition.

## FLUCTUATIONS IN THE PRICES OF ENGINEERING MATERIALS DURING 1923




The prices are all given in shillings. It should be noted that separate zeros are given for tin and copper, while the scales for these two metals are different from those for other commodities. The horizontal divisions are weeks, taken from Friday, January 5th, to Friday, December 28th. The scale of the diagram is such that it is comparable with our graph of last year as regards iron, steel and coal, but the scales for tin and copper have been reduced for the sake of compactness. In the case of coals the prices are those quoted for export, as it is practically impossible to give market prices for industrial consumption at home. Thus in South Wales the prices for inland consumption are sometimes 2s. per ton above, and at other times as much below, export prices. In Scotland the pithead price is generally some 2s. below the f.o.b. price, but carriage costs from 4s. to 7s. 6d., according to the distance. In the Midlands home prices are generally from 2s. 6d. to 4s. per ton less than those for export.

## Some Bridges of 1923.

A NEW rolling-lift bridge spanning the river Cart at Inchinnan was opened for traffic in March. Views of it are given in our Supplement. It is the largest bridge of its type in Scotland, and it comprises one opening span, one track span and one abutment at each end. The opening span measures 99ft. to the centres of the bearings, and when it is raised it gives a clear waterway of 90ft. between the timber fenders. The total length of the bridge over the abutments is 201ft. 6in. The west, or Paisley, abutment was constructed on reinforced concrete piles, which were driven to a depth of 42ft. below the bottom of the new river channel. The foundations for the track span had to be designed with special reference to the heavy concentrated load caused by the weight of the opening span, and for them four steel cylinders, or caissons, were employed. These cylinders were 14ft. in diameter for the bottom 16ft. or so of their depth, and then tapered off quickly to 9ft. in diameter. They were sunk under air pressure to a depth of about 45ft. to a firm foundation on boulder clay. When sinking was completed, the caissons were filled with concrete and were firmly braced together in pairs by means of heavy diagonal and horizontal steel frames. On their tops were mounted two main track girders, each of 29ft. 8in. span and 6ft. in depth. The top flanges of these girders have bolted to them milled cast steel track plates for the bridge to roll on. For the purpose of keeping the span in exact alignment, teeth are provided on the track plates, which correspond with recesses in the rims or track plates of the quadrant girders.

The floor of the track span is carried on cross girders attached to the webs of the main track girders, and the roadway floor is formed of 4in. of tar-macadam laid on the concrete filling over the buckled plating of the floor system. The roadway is 20ft. wide. The main girders of the bridge are each 99ft. long by 20ft. deep. The floor of the span is carried on cross girders attached to the bottom booms of the main girders, while the top booms are braced by a system of portal girders and diagonal bracings. The opening and closing of the span is effected electrically.

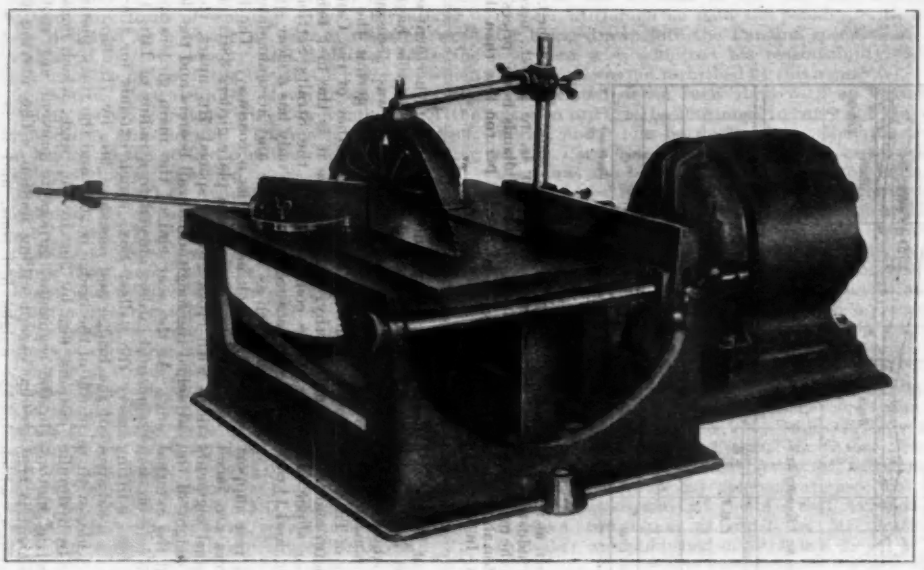
Another lifting-bridge illustrated in our Supplement is that over the river Wensum at Norwich, which was opened for traffic on June 27th last by the Prince of Wales. It was erected a short distance upstream and in place of a cast iron double-trunnion bascule bridge, which was no longer suitable for the traffic it was called upon to carry. The new bridge was designed to carry Ministry of Transport standard road trains, consisting of a 20-ton tractor and three 13-ton trailers, and pedestrians at 1 cwt. per super foot on the roadway not occupied by the road train, and 1¼ cwt. to the super foot on the pathways.

The track girders upon which the rockers rest support cast steel toothed track plates. The rockers are faced where they rock on these plates with cast steel segments holed to suit the teeth of the tracks. The weight of the structure on the two rockers is 250 tons, and the external load may rise that figure to 330 tons, *i.e.*, 165 tons on each rocker. The bridge comprises a track span of 18ft., a lifting span of 50ft. 6in. between centres of piers, and a fixed span of 29ft. 6in. It provides a roadway 22ft. wide, with a footpath, on each side, 7ft. wide. It is operated by hydraulic gear actuated by two 6 horse-power electric motors.

The third bridge illustrated in our Supplement is that which spans the lock in the Johore Causeway, which structure, though it is not yet completed, was sufficiently far advanced to permit of the commencement of passenger traffic on October 1st last, goods traffic having started a fortnight earlier. The bridge was necessary because a lock had to be constructed to permit the passage of vessels from one side to the other of the Causeway. It is noteworthy, first, because it is the first bridge of this type to be constructed in the Straits Settlements, and, secondly, because, though it only has a clear span of 32ft., it is as much as 57ft. wide and accommodates two lines of railway track as well as a roadway. The lifting span is made up of three main plate girders 38ft. long and 5ft. deep with cross girders, spaced 7ft. apart, to which are attached the longitudinal rail bearers and the floor troughing. At the rear end of the main girders are attached segmental girders curved to a radius of 14ft. 1½in., which carry the ballast box, which extends for the full width of the bridge and measures 9ft. by 7ft. 6in. The length of roll of the bridge is 20ft. and the track plates have projections, 6in. by 3in. by 2in. high, which engage in slots in the segmental girders to prevent any motion of the bridge except rolling motion. The moving part of the bridge weighs 570 tons, and it is operated electrically by a 35 horse-power motor.

## ELECTRICALLY-DRIVEN CIRCULAR SAW

THE HOLLIS WOODWORKING ENGINEERING CO., LIMITED, LONDON, ENGINEERS



## Society of Glass Technology.

A MEETING of the Society of Glass Technology was held in University College, Gower-street, London, W.C. 1, on Wednesday, December 12th, at 2.30 p.m., the President, Professor W. E. S. Turner, D.Sc., presiding.

Three papers were presented. The first, which was entitled "An Apparatus for Calibrating Burette Tubes," was by Verney Stott. It was explained that the method of calibration used was that of transferring successive quantities of water from the blank burette tube to a standard pipette. A piece of thermometer tubing was attached to the top of the burette tube by means of two pieces of rubber tubing and an adapter. The thermometer tubing controlled the rate at which air entered the top of the burette tube, and therefore controlled the rate of outflow of water from the burette tube. The pointing marks were made by folding a piece of black paper round the burette tube, and fastening it with secotine, so that the top edge of the strip coincided with the bottom of the water meniscus. Details of the apparatus and its use were described.

The second paper, "Some Factors Affecting Efficiency in the Glass Trade," was by Eric Farmer, of the Industrial Fatigue Research Board. The special problem discussed was the relative efficiency of different methods of dividing the working day. The investigation was carried out mainly in the Yorkshire district, where a change from the two-shift to the three-shift system had recently been made. The plan adopted was to select bottles which had been made for a lengthy period by the same "chairs" under both methods of subdividing the working day. It was found that the hourly output of the eight-hour shifts was practically in all cases greater, in the hand-made process, than that of the ten-hour shift. The increase was more marked in the case of large bottles than in the case of small bottles. With semi-automatic processes the results were the same. Corroboration was not obtained of the general opinion held in the glass trade that output was uniformly affected by hot weather. The effect of bad temperature conditions was cumulative, and tended to increase fatigue as the day went on. It was found that the morning shift was always the least efficient throughout the year, and this inefficiency was particularly marked during the heat of summer. There was little difference between the afternoon and the night shifts, though on the whole the night shift was less efficient than the afternoon shift. The effect of rest pauses was well known, but all stoppages of work were not so beneficial. The effect of stoppages due to the coal strike and the influenza epidemic was to lower efficiency, owing to loss of motor dexterity on the part of the workers.

The third paper was entitled "Specifications in the Glass Industry, with special reference to Soda-lime Glasses for Glass Containers," and was presented by Professor W. E. S. Turner. The subject had received emphasis, the author said, owing to recent occurrences involving the interests of both the general public and glass manufacturers and users. In some branches of the glass industry specifications had been employed, or, at any rate, some approach to standards had been made. For example, optical glass must possess a specific refractive index and dispersion. In the very important soda-lime glasses for containers, little had as yet been attempted in the way of specifications. There were two or three kinds of tests or specifications which might be applied, namely, specifications as to (*a*) composition, (*b*) use, (*c*) tests. For glass containers there were two essentials, (i.) durability and (ii.) a satisfactory state of annealing. Glass for common containers should contain not more than 18 per cent. of sodium oxide in the finished glass, and not less than 8 per cent. of lime or calcium oxide. The conditions for annealing varied with the composition of the glass, and could not be specified. There were, however, definite methods of testing glassware for strain, so that manufacturers and users might exercise control over their products or purchases. Specifications were then considered, for (*a*) medicine and drug containers, (*b*) beer and spirit bottles, (*c*) jam jars, (*d*) potted meat jars. The points to which particular attention had been paid were not the only ones the purchaser must consider. He would obviously take into account also such matters as correct capacity, freedom from sharp edges, and satisfactory colour or absence of colour.

## Electrically-driven Woodworking Tools.

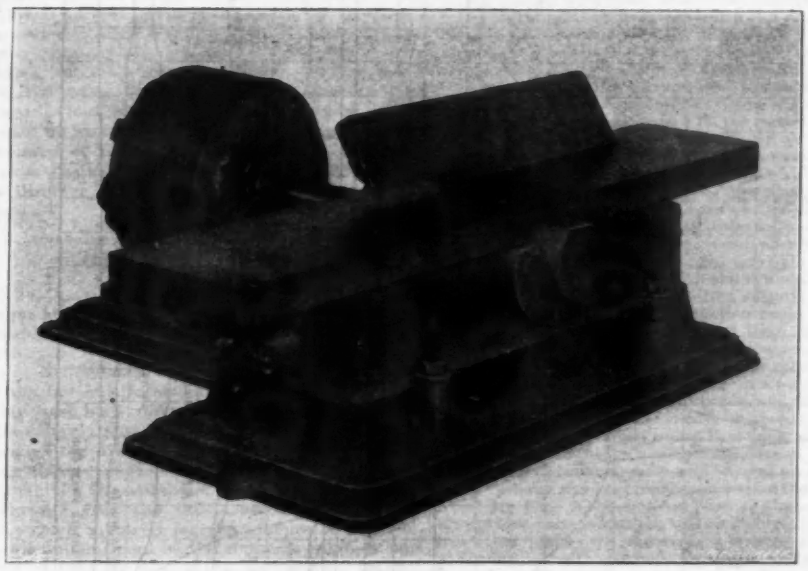
THE engravings which we reproduce herewith represent two handy little woodworking machines which have been put upon the market by the Hollis Woodworking Engineering Company, Limited, 95, Old-street, London, E.C. 1, with the idea of reducing manual labour in general carpentry and joinery.

They are both bench machines, and are driven directly by electric motors, so that their operation is not dependent on any other plant, except the electricity supply, and can, consequently, be used on any odd job without interfering with the running of the more important machines in the saw mill. The time and labour which can be saved on such work as sawing and planing by the substitution of mechanical power in the place of manual labour, needs no emphasis, and it appears to us that small adaptable machines, such as those under review, should find a very wide range of application in woodworking shops.

The first of the two machines illustrated is a 12in. saw bench driven by a 1 horse-power electric motor. Both the saw spindle and motor are equipped with ball bearings. The table of the saw bench tilts to permit of grooving work being done. The fence cants, and in addition a cross-cutting fence is provided, enabling repetition work to be cut off to dead length at any angle. An indication of the capacity of this bench is given by the fact that it will easily saw 3in. hard oak at the rate of 24ft. per minute.

The second type of electrically driven tool which we illustrate, is a bench planer. This small tool is made in two sizes; one is a 4in. planing machine, and the other is a 6in. The planer is directly coupled, on a cast iron base plate, to a 1 horse-power electric motor, and has a circular cutter block and canting fence. Ball bearings are provided throughout. The machine can be worked so as to give a really smooth finish to the work.

The electrical connections of the motors are always provided with an earthing wire, so that there is no fear of the workman receiving a shock from the framing, and the plug connectors are of a type which prevents the contacts being burned even in the hands of an unskilled worker.



ELECTRICALLY-DRIVEN BENCH PLANER

## SIXTY YEARS AGO.

THAT the position relatively to the magnetic meridian in which a ship is built affects the deviation of a compass subsequently placed on board her is nowadays an accepted fact. It was something of a novelty sixty years ago, and in our issue of January 1st, 1864, we find the report of a paper and discussion on the subject prominently displayed. The paper was presented before the Scottish Shipbuilders' Association—Mr. David Todd in the chair—by Mr. Paul Cameron, and was entitled "On Iron: Its Molecular Structure and its Magnetic Distribution." Mr. Cameron explained with considerable elaboration the supposed mechanism whereby an iron bar or plate acquired permanent magnetism as a result of being rolled, bent, cut, drilled or otherwise manipulated. He demonstrated the subject by cutting some strips of sheet iron in a north and south direction, and presenting them to a magnetic needle, when they were shown to possess distinct polarity. When the strips were twisted, their polarity was reversed. Other strips cut east and west, while attracting the needle, showed no polarity. He argued that the direction in which a plate was rolled at the mills and the directions in which it was cut, drilled, bent or otherwise manipulated at the shipyard before being built into the hull all left their mark on the magnetic condition of the completed vessel, and that their influence was not obliterated by the additional magnetic effect produced by the riveting stresses. Incidentally, he expressed the view that the direction in which a plate or other iron member was rolled or forged affected not only its magnetic properties, but also its tensile strength. It may perhaps be of interest to some if we mention that among those who took part in the discussion of Mr. Cameron's paper were, besides Mr. Todd, Mr. Mansell, Mr. Curle, and Mr. John D. Napier. . . . In the same issue we recorded the launch at Chatham of the iron frigate Achilles, the first large iron vessel to be laid down—although not the first to be launched—by a Government dockyard. When the order to build the Achilles was received at Chatham from the Admiralty in April, 1861, there was not a single machine for iron shipbuilding in the yard, and five or six months had to be expended in obtaining and fixing the necessary equipment. Soon after actual work on the Achilles had been begun, it had in a measure to be suspended, as a result of the receipt of instructions to build the ironclad frigate Royal Oak, which vessel was completed, equipped and sent to sea from Chatham in eighteen months. Unlike the Warrior, Black Prince, Defence and other ironclads built in private yards, the Achilles was armour plated, not only on her broadsides, but right round from stem to stern, and for a length of 200ft. on each broadside the armour—4½in. rolled iron—was carried up to the floor of the fighting or weather deck. Her launch was attended with great difficulty. She was built in a dry dock, but at the first attempt it was found that the tide water, when admitted to the dock, did not rise sufficiently high to lift her off the blocks. On the succeeding tide she was successfully floated, but when being towed out into the stream she stranded on a sandbank. The efforts of five steamers and several hundred men at capstans were required to get her off.

THE London, Midland and Scottish Railway Company announces that about a dozen Royal Academicians and half a dozen Associates of the Royal Academy have agreed to paint posters for the company. The posters will appear in the spring.

# Provincial Letters.

## THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

### Prospects for 1924.

THERE are distinct signs that trade in the Midlands and Staffordshire will be better in 1924 than it was during the past twelve months. There is little doubt that, although 1923 was a most trying year and business of a spasmodic character during the greater part of it, Midland firms as a whole had a more satisfactory year than they had anticipated. A better tone has been in evidence in the iron and steel and engineering industries in the last few weeks, to which the settlement of the boiler-makers' dispute has contributed. The revival of activities in the shipyards, the huge schemes of the leading railway companies, and the steadily increasing operations on the part of the various municipalities, will provide a large amount of employment during the opening months, if not over the greater portion of the year. Provided that conditions in the political world, both at home and abroad, do not take any violent turn, there is every reason to believe that, with returning confidence there will be a sufficient volume of trade released to keep most of the iron and steel works of the Midlands fairly fully employed. Before manufacturers can look ahead with any degree of certainty, however, there are two essentials to be established—first, confidence, and, secondly, stability both at home and abroad. With a return to anything like stability on the Continent, conditions here would be greatly improved. The outlook, though not without its anxious features, is regarded with cheerfulness. Order books are better filled than they were a few months ago, and prices have been lifted from the unprofitable level which recently ruled. More work is confidently anticipated on all sides. The Staffordshire iron and steel trades will benefit by the large orders placed within the last fortnight for railway wagons, the rolling stock orders requiring fairly large quantities of iron and steel bars, stampings and other material for wagon construction. A number of firms in the neighbourhood of Birmingham expect to obtain orders for tubes and other essentials in connection with the orders given out for locomotives. The Midland chain and anchor makers are, after a long period of depression, looking forward to an increased demand for their products. The foreign demand for iron and steel is gradually developing, and the position is rather hopeful with regard to Near East business. Russia is in the market for fair quantities of material, and good business with that country is quite a likely feature during the ensuing year.

### Engineering Activities Slowly Advancing.

The engineering industry is finding a gradual improvement, after having experienced a very trying year. It cannot be said that the industry is quite out of the wood as yet, but some branches are much more active, while in others inquiries are increasing. The New Year finds the majority of Midland firms with some little business on hand, and prospects of increased activity. The outlook in the mechanical and electrical sections is brighter than it has been for a considerable period. In addition to the requirements of shipbuilders and railway companies, there is a large number of electricity, gas and water supply schemes. The improvement here should result in a much-needed fillip being given to the machine tool trade, possibly the dullest section of the engineering and allied trades. Machine tool makers have passed through what has undoubtedly been one of the most difficult trading periods in history, but, happily, many adverse factors have now been removed. Orders for grinding machines, lathes and other equipment are now being given out in connection with the reorganisation of the railway engineering shops. It is in that direction machinists are looking for a fresh impulse this year. Another quiet department is constructional engineering, a line in which the Midland firms, by reason of their distance from the seaboard, are not so well situated as those at Liverpool, Manchester and Middlesbrough. They were successful competitors, however, for bridge and harbour work during the past twelve months, and hope for improved business this year in structural contracts, both for home and abroad.

### Optimistic Wagon Builders.

Optimism is very prevalent in Midland rolling stock building circles, where some firms have sufficient work to ensure their being busy for the next six months at least. Local companies have received a substantial tonnage of the recent railway orders, and few firms in the engineering world are better placed than the railway carriage and wagon companies. Further, they anticipate participating in the large orders yet to be given out by other railway companies.

### Birmingham Brass Industry.

The majority of the brassfoundries in the Birmingham area are fairly well employed, and for this founders and stampers have partially to thank the introduction of wireless. The renewal of business in the shipbuilding yards is expected to provide an improved demand for ships' berths and fittings, and brassfounders anticipate that 1924 will provide them with a noticeable expansion of business in all departments of the trade.

### Steel Works' Good Orders.

Most of the Midland steel works commence the year with good order books, and all are looking forward to brisk business during the first months of the year. Some substantial orders have already come along, and the demand for steel for the various development projects which have recently been announced by the railway companies, municipalities and private institutions is sure to be great. Foreign competition will have to be combated, and that steelmasters realise the danger from this quarter is evidenced from their cautious handling of prices. The recent increases in steel prices resulted in some heavy buying of foreign material and big shipments from Belgium have begun to reach this district. Steel makers at home have found it impossible to maintain the recent selling price of £8 15s. for mild steel billets, the level having fallen to about £8 10s. Against this, it is possible to buy Belgian billets at £7 5s. Sheet bars are about the same price, and here, too, Belgian bars are on offer at less money. Finished products are less affected by outside competition. English bars are £10 15s. to £11, and bedstead angles are £11. Angles and joists command £10, and tees £11. In finished material the chief competition is in joists, obtainable at £6 18s. 6d. f.o.b. Antwerp, or £8 3s. 6d. delivered. Prices of steel scrap which recently receded to £4 10s. remain firm.

### Pig Iron Outlook.

The closing months of the old year were productive of a volume of new business in the pig iron department, sufficient to give producers a good start in the New Year. In the Staffordshire, Shropshire, Worcestershire and Warwickshire areas the number of blast-furnaces now operating is sixteen, one fewer than a year ago, though in the kingdom as a whole the total is now 188, as compared with 169. In the districts from which the Midlands chiefly derive their supplies of raw iron—Derbyshire, Leicestershire, Nottinghamshire, Northamptonshire and Lincolnshire—there are 55 furnaces in blast to-day, against 41 a year ago. The handicap of high production costs is severely felt in South Staffordshire, but it is anticipated that the heavy demand for materials necessary to carry out the numerous contracts for home railways, &c., will call for the restarting of additional furnaces in this district in the course of a month or so. In view of the improved outlook, certain Black Country furnaces, which have been idle for a long period would resume operations almost at once, but for the impossibility of obtaining the requisite fuel. The shortage of coke is indeed the most disconcerting feature in the outlook. Owners of idle blast-furnaces cannot afford to go on the market and outbid the people who are struggling for supplies of coke. Furnaces already in blast are in a superior position, as they have their contracts for coke at 24s. at ovens, and will look for deliveries at that figure up to the end of March, the duration of the understanding reached a month ago at a conference between representatives of Midland furnaces and of the cokeries. Smelters seeking supplies to-day are asked several shillings per ton above the 24s. basis. It is hoped that supplies, which are scarce, will improve now that the Ruhr coke ovens are gradually resuming normal activity. Although there is a lull in pig iron buying at the moment, recent contracts have placed the furnaces in a fairly strong position. Forge iron contracts have been better lately than for a long time past, the makers of finished iron showing keenness in getting their requirements covered. Foundries also have been taking iron more readily. Prices which were advancing when the year went out are maintained, the efforts of buyers to get them down proving of no avail. Indeed, producers state that higher values in the near future must be expected. Meanwhile, quotations are firm at £4 15s. for Derbyshire No. 3 foundry and £4 13s. 6d. for Northamptonshire, with forge qualities ranging from £4 6s. 6d. to £4 10s.

### Manufactured Iron Business Expanding.

Staffordshire finished iron mills generally did not have a rosy time during the past year, but the latter months witnessed some little revival in business, and this is now expanding. Good tonnages are still required to ensure full employment, but ironmasters are hopeful that these will be forthcoming in the first quarter of the year. There is some gratification at the recovery of useful foreign customers who have not been heard of in recent years. Russian agents in London are stated to be offering business which is likely to materialise, provided financial arrangements are satisfactory. Producers of marked bars find a ready sale for their products at £14 10s., and there is every likelihood that the calls upon them in 1924 will be much greater than was the case, even in the closing stages of the past year. The Midland firms which have received contracts for the supply of railway wagons will require large quantities of iron bars, &c., and the Staffordshire mills are sure to get a fair share of the business. Makers of Crown bars who have been enabled to raise their selling prices of late, find that in most cases they can still command £12 10s. for good class bars. Nut and bolt requirements are increasing gradually with the progress of constructional work and of activity in the shipyards. Manufacturers are by no means pressed, but it is something that business after a long period of stagnation is progressive. There is a good demand just now for nut and bolt bars, and Staffordshire makers, who have an advantage of 10s. per ton over their Lancashire rivals, are securing a greater proportion of the business coming on to the market. They continue to quote £11 against the Lancashire figure of £11 10s. There is a fair amount of forward contracting in this branch, which is a healthy sign. Wrought iron gas tube strip remains firm at £12 10s. to £12 15s. per ton.

### Strong Position of Sheet Mills.

The galvanised sheet trade, after a big rush of business, opens the New Year in a strong, though quiet manner. The mills are assured of activity in the first quarter of the year, and additional mills are likely to be put into operation as soon as business begins to show itself again. New work is not forthcoming to any extent at the moment, but mills are content to await the export orders which they have little doubt will be forthcoming in the near future. Prices, however, are slightly easier than of late, the lower price of £18 15s. having been, in a few instances, further shaded.

### Railway Developments.

Railway developments of considerable importance to the Midlands are included in the £10,000,000 programme of new work about to be undertaken by the Great Western Railway Company. Two rural areas on the edge of the Black Country are to be opened up for residential and industrial developments by new lines from Wolverhampton through Kingswinford, and from Stourbridge Junction to Kinver. Stourbridge is also to be provided with a new locomotive depôt, costing £119,230. A new tunnel is to be constructed under the Malvern Hills to supplement the existing single-line tunnel, at an estimated cost of £1,000,000.

### Cannock Chase Coalfields Activity.

The prospects for the Cannock Chase coal mining industry in the New Year are brighter than they have been for some years past. The biggest industrial consumers of coal around Birmingham and the Black Country are calling for more fuel than the local coalfields can supply, in spite of the fact that every mine in the district is working up to its full capacity. Not since the days of the war has Cannock Chase experienced anything like the demands now being made upon it. Only two or three months ago many of the pits were not working more than three days a week. Now, three seven-hour shifts are the rule at most of them. It is stated that many of the pits have contracts which will keep them busy until June. Unemployment amongst the 20,000 or 25,000 miners living on the Chase is virtually non-existent. Indeed, it is stated that work could be found for two or three thousand additional hands. At the West Cannock Colliery, where during the past year modern plant has been laid down, production has increased from 7000 tons in 1918 to 17,000 tons. During the past year a considerable outlay was incurred in the laying down of new railway sidings near the Brindley Heath pits, and electrification of plant took place on an extensive scale. The general effect of the various improvements has been to put West Cannock in a more efficient state than it has ever been in its history. At the Cannock and Leacroft collieries two new seams have been opened up, making a total of eight seams now being mined. An increased output of 200 tons of coal per day is being raised from the 8ft. and the 4ft. seams in question. Every effort is being made to cope with the rush of orders, which are attributed to a general revival of industry, and not merely to the seasonal demand, and it is hoped to open up two more coal seams and employ additional labour at the pits.

### Increased Wages for Miners.

The ascertainment of the wages of the miners in the Cannock Chase area for January and February shows an increase of 7d. a shift for stallmen (minimum wage), compared with the wages in November and December. The wages of stallmen will thus be 10s. 3d. a shift for the next two months, as compared with 9s. 10d. in January last year. Firemen and examiners receive a rise of 8d. per shift, shot lighters 7d., pikemen, rippers, loaders and datallers 6d., dirt emptiers 5d. Boys' wages are advanced by from 2d. to 4d. per shift, according to age.

### Unemployment.

The Midland unemployment returns may not be an infallible index to the state of trade, but no matter on what trade inquiries are made, employment has steadily become more regular. For many weeks past the official figures have shown a falling off in the number of persons registered as having no work, and it is confidently anticipated that as the weeks of the new year go by the numbers will continue steadily to decline.

## LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER, Thursday.

### General Outlook.

THE opening of the year finds the iron and steel markets in a very much more cheerful condition than has been the case for about four years, and it seems to be assumed that a very much better prospect is now in view both for merchants and for manufacturers. No doubt the latter have suffered most from the untoward conditions of trade, as they are less able to adjust themselves to a falling market than the merchant firms. Steady, or rising, markets are needed if manufacturers are to do well, and these are quite generally expected in 1924. It may be hoped, therefore, that the shareholders in our great iron and steel establishments will have a more comfortable time. In the absence of anything disastrous happening in the political world, it is quite probable that a period of greater prosperity in the iron and steel trades may date itself from January, 1924.

### Metals.

It is unfortunately not possible to look at the trade in non-ferrous metals with the confidence with which so many people are now regarding the iron and steel trades. For one thing, the output of the non-ferrous metals did not fall away as was the case with iron and steel. Lead and tin have not been produced excessively, but there is no doubt that copper output has shown no sign of adjusting itself to the state of consumption; and, as a consequence, copper is relatively one of the very cheapest of the metals. Copper was at a fairly low price when the previous year opened, but at the close it was £4 per ton cheaper, and the feeling in the market here is certainly more depressed. The fact is, that during the past twelve months people have so often hoped for higher prices—and even calculated upon them—and been disappointed, that it is now extremely difficult to get up confidence in the future; and yet the probability is that, at any rate in Great Britain, the demand for copper in connection with the engineering industries, will be fairly large, while the railway schemes are being carried out. The present prices for electrolytic and best selected ingot copper certainly suggest that it will probably be wise to secure sufficient stock for any work that has been contracted for; and it does not seem improbable that the prices at the opening of January may be the lowest of the year. No doubt sheets, flat-bottoms and tubes appear too high from the consumers' point of view, but it is doubtful whether any concession will be made in these prices. All prices for the scrap metals remain low, and although dealers do not, of course, quote the lowest possible

prices when they offer to the engineer, yet the prices at which gun-metal and yellow brass scrap can be bought are ridiculously low. In some parts of the country it is said that £42 per ton is all that dealers offer for scrap gun-metal. In Manchester, however, up to £46 is usually paid by dealers; but good gun-metal, at £50 per ton, is a very cheap material for the engineer who is not bound down to a strict specification. Tin has been rather quiet of late, there having been but little business moving, but there seems still to be a favourable situation in this metal; and there is no doubt that during the year the reserve stocks of tin have been seriously reduced. Tin is a difficult metal to prophesy about, but the chances seem in favour of the higher prices this year. Lead is fairly steady, and maintains a comparatively high value. Spelter is perhaps a little firmer than it was, and as the price is low there would seem to be a good chance of better values in the near future.

**Pig Iron.**

The market for foundry iron this week in Manchester is still very quiet, so far as new business is concerned; but the tone is firm, and there is some expectation of rather better prices later on. The actual buying of pig iron has been held up to a large extent for a whole fortnight, and no doubt some resumption of activity in this respect may be looked for next week. The closing prices of the year show no change either in Cleveland or in Scotland, and in the latter market the New Year holidays will hinder any movement for a time. Ironfounders in the Lancashire district are reported to be busier, but, of course, they have a fair tonnage of foundry iron already bought in view of this increase in consumption. There is really very little to be said yet about the foundry iron market here; we shall have to wait until next week before any view as to the immediate future can be developed.

**Steel.**

The demand for manufactured steel is in abeyance at the moment; but the feeling in this section of the market is very firm, and sellers, as a rule, seem to think that a further small advance in the official prices is not unlikely. At present the quotation for joists and angles is £10 per ton in Manchester and 57s. per ton more in Cheshire, and from £10 10s. to £10 15s. is quoted for steel plates.

**Scrap.**

There is as yet no actual increase of business to justify the very strong feeling which is noticeable in the scrap market, but for this no doubt we must expect to wait a week or two. That the demand for manufactured iron is better everyone admits, and this must eventually have a stimulating effect on wrought scrap, which is a much more economical material for bar-iron making than forge pig iron at present prices. Hence dealers are inclined to hold wrought scrap rather than sell it at low prices. Steep scrap is quiet, and neither Wales nor Sheffield is yet inclined to buy except at prices lower than those of mid-December; but dealers are fairly confident that the demand for steel scrap will very soon revive. Holders of good cast iron scrap quote 95s. per ton for the best qualities and 90s. for ordinary broken machinery metal; but they are expecting much better prices so soon as the foundries come into the market again. They hope that during the next six months this class of scrap will again come into the normal relation with pig iron prices.

**Engineering Trade Outlook.**

Although there is no likelihood of a return to pre-war conditions in the engineering trades of this or any other district until our foreign customers have been set upon their feet again, it cannot be gainsaid that 1924 augurs better than 1923. On nearly all hands one hears of some improvement in trade. The extent of the improvement varies very much, but definite proof is provided by the figures supplied by the local Labour Exchanges. These show that the number of unemployed persons in the principal Lancashire towns is steadily if slowly decreasing. The better conditions are, of course, due in some measure to the large amount of railway and Government work which has either been given out or decided upon. When our railway workshops and shipbuilding yards are actually employed, they quickly make their influence felt in other branches of engineering. It may be said that all the locomotive building plant in Lancashire and also Cheshire, whether owned by the railway companies or otherwise, if not yet fully occupied, will shortly be so. Beyer, Peacock and Co., Nasmyth, Wilson and Co., and the Vulcan Foundry Company, at Newton-le-Willows, have all recently received orders which will keep them well employed for some time. The machine-tool makers are not making much headway, but even in this branch there is a more cheerful report. The outlook for the builders of textile machinery is, I regret to say, by no means bright. The textile machine works at Oldham, Bolton, Blackburn and Burnley are nearly all on short time, and in this branch of engineering the present state compares very unfavourably with that of twelve months ago. Still, the textile machine makers have, on the whole, had a very good time since the war, while other branches of the industry have been suffering. The local makers of internal combustion engines are still by no means happy, the export trade with Central Europe and Russia having affected this section of the industry very adversely. "Russia," said an engineering friend who has recently been out there on a business trip, "has been set back 100 years, and seems quite satisfied to remain in that wretched condition.

BARROW-IN-FURNESS, Thursday.

**Hematite.**

There is nothing fresh to report of the hematite pig iron trade beyond the statement that prospects are good for the New Year. The holidays have made the market quiet momentarily, and as the steel works have been closed there has been more iron available for other purposes. This is not likely to remain in stock for any length of time. Now that the shipbuilding and engineering trades are briskening up there is a likelihood of much more business in the early future quite apart from other sources of orders. With the renewed confidence in the iron and steel trades generally there will be a greater tendency to place orders for forward delivery instead of following the recent practice of ordering just for immediate requirements. There is some chance of the continental trade improving, and also the American business, but this will be slow. There are no signs of more furnaces going in at the moment, but as trade improves, as it is expected to do, this is only a question of time.

**Iron Ore.**

The iron ore trade is quiet as yet and there are not many signs of a great improvement in the early future. Most of the ore is being used in the district, but there is a limited quantity going to Yorkshire and Scotland. None of the mines are busy and some are doing very little. The amount of business in foreign ore is not great, nor is it likely to be until there is a considerable improvement in the iron trade.

**Steel.**

The steel trade is more promising, but no steel has been turned out during the holidays, as both the Barrow and Workington mills have closed down. The Barrow works restart on Monday next, but Workington will not begin again until the middle of January. The hoop and section mills have sufficient orders to last for some time, and, as far as Barrow is concerned, the rail orders will ensure employment for a month or two.

**Shipbuilding and Engineering.**

There have been only short holidays in the engineering and shipbuilding works, and there is a possibility of certain departments becoming busy in the course of a few months. This remark particularly applies to the boiler shops, which are well booked with orders for marine and locomotive boilers.

## SHEFFIELD.

*(From our own Correspondent.)*

**Good Prospects for 1924.**

The New Year opens with a feeling of confidence that the steel trade will do much better than it did in 1923, and that the city will make some progress towards the recovery of its old prosperity. It would be too much to say that anyone expects to see a return to normal conditions during the year, for both productive capacity and working class population have increased so greatly since the war that only exceedingly good trade can fully absorb both; but there is a general belief that a substantial improvement will take place. There was a similar feeling of confidence a year ago, based largely on the increased activity which the basic furnaces had been showing for the previous two or three months. Unfortunately, that feeling proved to be hardly warranted. By the middle of the year, employment at the furnaces had fallen away to a considerable extent, and a good deal of slackness prevailed. The other branches of trade failed to make much headway, and although the number of unemployed in the city fell during the year by 10,000 or 12,000, there are still 28,000 on the books of the Employment Exchange.

**Some Hopeful Factors.**

It is earnestly to be hoped that this year's goodly prospect will not flatter to deceive, in the same way that its predecessor did. There are grounds for believing that it will not. The basis of hope now is broader. Not only has history repeated itself in the case of the basic steel trade, but the condition of acid steel shows a notable improvement. The large orders for railway marterial, which had been expected ever since the beginning of last year, are now apparently about to be given out; in fact some, for considerable quantities of rails and rolling stock, have already been placed. It is believed that a good stream of them will roll in, and that the axle, tire, spring and buffer departments, which make up a large proportion of the heavy side of the steel trade, will have a very good share of work. The spring shops are, indeed, working practically full time at present. The Government's proposal to lay down a number of cruisers to take the place of the "County" class, which is expected to be carried into effect early this year, will bring much work to the armament, engineering, and engineers' tool departments. The heavy steel foundries are benefiting from the building of locomotives, which calls for considerable supplies of wheel centre castings, and of forgings of various kinds. The making of wagon wheels and axle-boxes is providing a good deal of work for the iron foundries, while large quantities of wrought iron and steel are wanted for the underframes of wagons. The crucible steel trade has been gradually growing strong for some months, and, now that Government surplus stocks are at last exhausted, or thereabouts, the call for newly-manufactured steel and tools should certainly be on a larger scale than it has been for the last three years. In various departments, the amount of work actually booked at the moment is sufficient to provide employment for half the year, and, given freedom from labour or other troubles, the New Year ought to render a good account of itself.

**Saw Trade Busy.**

A state of activity is reported in the saw department, and the amount of skilled labour available is said to be insufficient. This is one of the branches which is being called upon to assist in repairing the havoc wrought by the Japanese earthquake, and large circular saws are being sent out for use in the reconstruction of the devastated cities. Japan is, in fact, calling for products covering a wide range, from heavy structural shapes to nuts and bolts. The saw department is also finding a ready sale for its hand tools, but there is less demand for metal-cutting saws.

**Cutlery and Plate.**

In these trades the houses which are busy with contracts for Government departments and large caterers had but a brief holiday, as the work must be pushed on without delay, but in most other cases the stoppage was a lengthy one. The outlook for the coming year is uncertain, but it is thought probable that an improvement will be experienced. A forward movement in the general trade of the country will, of course, benefit these branches by increasing the purchasing power of the people generally. German competition having fallen off, there are good grounds for hoping that the better state of things in the pen and pocket knife, scissors, and razor departments, which has been seen during the past few months, will be maintained. The trades depend largely on the overseas markets, and it is expected that the British Empire dominions will continue to do well for them. The Admiralty and War Office are at present placing their annual contracts for tools, cutlery, and plate, and there is keen competition for them, although the quantities specified are much less than those of pre-war days.

**A Lead Mine in Cumberland.**

The recent news of the revival of the old lead mining industry in Derbyshire can now be followed by the report of the successful location of lead at a Cumberland mine, the property of a Sheffield firm. The mine is that of Threlkeld, an old one which has been a very trying undertaking to some of its owners. The last company to which it belonged lost £75,000 on it. One of the shareholders in that concern was Mr. G. S. Marple, of Marple and Gillott, Limited, iron, steel and metal merchants, Sheffield, and when the mine came into market four years ago, he bought it for his firm. Since then, persistent efforts have been made to discover a vein of lead which was known to be on the property, and, after the expenditure of much money and the installation of elaborate machinery for boring purposes, it has at last been struck, and has been found to be of good thickness and rich quality. No time will be lost in developing the mine, which will find employment for several hundred men. Messrs Marple and Gillott are building a wooden village on the spot, having purchased a large number of Army huts from Gretna Green and transformed them into comfortable dwellings. The Cumberland County Council has decided to lay down a new road to facilitate transport to and from the mine.

**An Interesting Appointment.**

Dr. J. Neill Greenwood, who is at present in charge of the research department of Messrs. Samuel Fox and Co., Stockbridge, has been appointed first Professor of Metallurgy at the University of Melbourne, and leaves for Australia about the middle of next month. Dr. Greenwood is a comparatvely young man, and has had an interesting career. While employed as an assayer in the lead smelting works of Messrs. Quirk, Barton, and Burns, at St. Helen's, he attended evening classes at the St. Helen's Municipal Technical School, where he gained a scholarship which enabled him to pursue his studies at Manchester University, under Professor C. A. Edwards. He graduated in 1916, and then took an appointment in the research department of Messrs. Armstrong, Whitworth and Co. It was in 1919 that he joined Messrs. Fox and Co. as chief physicist in the research department.

**Sugar Beet Progress.**

An important development of the sugar beet industry in Nottinghamshire was announced at a meeting of the county branch of the Farmers' Union last Saturday. Major T. S. Impey attended as representative of a company which proposes to erect a new factory at Colwick, in the immediate neighbourhood of Nottingham. He said he could not give names at present, but four big shipowners of Glasgow and Sir Ernest Jardine, of Nottingham, would take a leading part. The company would be run with British capital and on British lines, and the factory was to be completed for the 1924 crop next October.

**Municipal Schemes.**

Sheffield Corporation has prepared a number of new schemes, to be carried out during the present year, for the purpose of relieving unemployment. The whole programme for the improvement of highways, strengthening river bridges, and making new roads, involves an estimated expenditure of £306,055. The largest item is the widening of Worksop-road, at a cost of £85,000; and a new road is to be made from Bocking-lane, Woodseats, to Greenhill, at an expenditure of £40,000. There are seven or eight bridge schemes, the largest being that at Broughton-lane, which will cost £30,000. Rotherham Corporation has on hand a project for the reconstruction of Bow Bridge, on the Rotherham-Sheffield main road. A report presented this week shows that the estimated cost has been reduced to £27,415, and that the Ministry of Transport favours a grant of 50 per cent. of the amount.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

**A Retrospect.**

THE past year was a most trying and difficult period for all associated with every branch of industry in the North of England, but it is gratifying to record some measure of recovery from the severe slump in trade experienced during the preceding twelve months. The improvement in trade during 1923, as compared with 1922, was only relative, and the balance sheets of the great industrial concerns, which, almost without exception, have been unable to pay a dividend on the ordinary share capital, are eloquent of the difficulties which had to be encountered. But the silver lining to the overhanging clouds has revealed itself, and all the indications are that the worst has been left behind. The iron and steel trades, in particular, passed through very troubled times, and had a severe struggle in coping with adverse conditions at

home and abroad. The Franco-Belgian occupation of the Ruhr dealt at those industries a blow, the effects of which are still severely felt. It completely destroyed the German currency system, and although the vitality of our trading relations with Germany is such that it survived this shock, the exchange of goods between the two countries has been cut down to a minimum in consequence of the difficulties of finance. Prior to the war Germany was a very heavy buyer of Cleveland products. To a less degree also the French and Belgian exchanges collapsed, giving these foreign competitors a temporary, but none the less real, advantage in the competition for business in the markets of the world. Iron and steel makers had also to contend with a general depression of home industries. The loss to industry occasioned by the boilermakers' dispute was incalculable. Ten times the number of men directly involved in the dispute were laid idle, six months' shipbuilding output was lost, other contracts were sent abroad, and again the iron and steel trades suffered severely. The Northern coal trade had a fairly satisfactory year, but this was chiefly due to the cessation of a big proportion of the coal output of the Continent as the result of the occupation of the Ruhr. There ensued a big demand from abroad, and prices rose to phenomenal levels. The coal trade's prosperity, however, was bought at the expense of other home industries, and, as the biggest coal consumers, the iron and steel trades were the chief victims.

### Cleveland Iron Trade.

The course of the Cleveland pig iron trade has been beset with many difficulties during the past year, but at the close the position is much brighter than might have been expected. Consumption is now definitely on the up grade, orders are flowing in more freely, and there are substantial grounds for hoping that 1924 will mark a further big step towards the complete restoration of the trade. There was a steady demand for the Cleveland product during the year, but costs of production were excessive, and for many months some of the local steel-making firms with their own blast-furnace plant have found it more profitable to keep some of the latter idle, and to supplement their output of pig iron by purchases in the open market. In other words, it paid better to buy iron than to make pig iron. This state of affairs was brought about chiefly owing to the huge demand for fuel from the Continent and consequent high prices, and although pig iron producers established their claim to a preferential rate, the price of blast-furnace coke rose as high as 45s. per ton in the spring, and at the close of the year stood at 39s. per ton delivered at the works. There is an old formula in the Cleveland iron trade that No. 3 G.M.B. Cleveland pig iron should be three times the price of coke, and on this basis No. 3 should not be 100s. per ton, at which figure it now stands, but actually 117s. per ton. But at 100s. per ton—twice the pre-war figure—Cleveland pig iron is still too dear. During the year a good deal of export trade was recovered, but foreign sales of Cleveland iron are still restricted by the high prices which have to be charged. Despite the exchange difficulties, however, Cleveland never ceased to export iron to all the countries of Europe, and Germany, strange to say, was the best customer. In January of last year No. 3 Cleveland sold at 105s.; a month later it touched 120s.; and by the middle of March 127s. 6d. was paid, that figure representing the "peak" price of the year. The boom, however, quickly died down, and a policy of price-cutting continued from April to October, when business was done as low as 95s. 6d., but by the end of October the price had again advanced to 100s., and at that figure it has remained ever since. The average quoted price for No. 3 Cleveland for 1923 is 108s. 7.85d. per ton, compared with 90s. 7.66d. in 1922, 144s. 0.79d. in 1921, and 209s. 5.22d. in 1920. At the close of the year there were fourteen blast-furnaces on the production of Cleveland iron, as compared with ten at the beginning. The outlook is regarded as distinctly encouraging, and it is expected that several additional furnaces will be put into operation in the near future.

### Hematite Pig Iron.

Low prices, limited demand and high production costs were the salient features of the hematite pig iron trade during the past year. There were several occasions when mixed numbers were sold at prices appreciably less than Cleveland foundry iron, which indicates the trying times the makers passed through. The year opened with East Coast mixed numbers quoted at 93s. per ton. The price reached 100s. at the end of the month, 115s. at the end of February, and from the middle of March until the beginning of June kept steady at 122s. 6d. per ton, that being the highest figure of the year. Thereafter, there was a steady decline, and subsequently a slow recovery to the present figure of 102s. per ton.

### Manufactured Iron and Steel.

The manufactured iron and steel trade made a very welcome recovery during the past year in face of keen foreign competition. A year ago we had to deplore the fact that whereas the national output of steel had increased by 2,000,000 tons, the production on the North-East Coast had actually declined. This was directly attributable to the slump in shipbuilding, the prosperity of which is so closely associated with that of the local steel works. But producers worked out their emancipation from a too complete dependence upon the shipbuilding industry, and cultivated other markets for their manufactures with gratifying success. As a result, the output of steel on the North-East Coast increased considerably, the aggregate being estimated at 1,600,000 tons, as compared with 912,000 tons in 1922. On the year, prices showed a decline of from 20s. to 30s. per ton. During the past few weeks a considerable volume of orders for steel has been placed, and manufacturers start the New Year confident of a progressive improvement.

### The Coal Trade.

The Northern coal trade is more or less slow and under holiday influences at the time of writing, with only a formal and detached attention to business. The only item of importance in circulation is the renewed buying for German railways and other industrial concerns, rendered possible by the extensive credits recently stated to have been arranged in London, the bulk of which is to be spent on coals and much of which is expected to be expended on the North-East Coast. This, of course, is all in prospect. Actually, at present business for export is very quiet. Prices show no alteration on the week.

## SCOTLAND.

*(From our own Correspondent.)*

### A Poor Year.

In all, or practically all, departments of industry the record for the past year was one of decreased activities; in fact, the twelve months just ended were one of the poorest, if not actually the worst, period since the end of the war. Each succeeding year since 1918 has opened in promising fashion, only to be met with a definite setback in the form of some large industrial dispute. In this respect the year 1923 was no exception. The first three months showed distinct promise, but the commencement of the boilermakers' dispute put an end to all hopes for the period. The situation created at the shipyards affected all allied industries, and the steel works and iron-works in particular had an exceptionally lean period. The demand for steel plates and sections suffered to a large extent, and likewise affected the position of pig iron. For a time it appeared as if the output of the latter would be discontinued. A scarcity of foreign materials, however, obviated the necessity of closing down altogether, and the works managed to carry on in a small measure until the end of October, when the shipyard dispute came to an end. The effect on shipbuilding was most pronounced. The total launches on the Clyde during 1923 only amounted to 122 vessels, of 175,528 tons aggregate, with engines of 166,956 indicated horse-power, compared with 143 vessels, of 388,481 tons and 349,329 indicated horse-power in 1922. These figures make poor reading when compared with the returns for 1913 of 370 vessels, of 756,976 tons and engines of 1,111,440 indicated horse-power. Once again, however, the end of a year holds promise of better things in store. A fair number of shipbuilding orders have been placed, and if steel and other materials can be kept at a reasonable figure, industry in general is bound to benefit to a considerable extent. During this period of depression, the coal trade stood out as an exception to the general rule. The situation in the Ruhr created a heavy export trade to Germany, Scandinavia and continental ports, which at one time threatened to submerge the home trade altogether. Enough foreign business was booked to carry the collieries right up to the end of the year at least, and it is questionable if old contracts have even yet been cleared. Prices of coal fell at periods, but the general effect of the foreign demand was to uphold quotations at a high level. As has already been said, the outlook for 1924 is encouraging, and once again it is hoped that the ensuing months may be free from industrial strife. In this connection, it is hoped that the miners' ballot may not be the forerunner of further strife. The uncertainty of the political situation is another drawback, but an early settlement in the interests of the industrial community may also be anticipated.

### A Holiday Week.

Little or nothing in the nature of fresh business has been done in the various markets during the past week. All energies have been directed to clearing off as much old business as possible before the stoppage for the New Year holidays.

### Steel and Iron.

New business has been on very moderate lines. Apart from the holiday feeling referred to above, the recent advances in prices have threatened to arrest forward buying. More new work is undoubtedly waiting to be placed, but there is now just the chance that consumers may turn to the cheaper continental material whenever possible, unless local producers can be induced to modify charges in order to keep business at home. New business in pig iron for home consumption has certainly fallen off somewhat of late, but, of course, this may be only a temporary lapse. Bar iron works are comparatively well placed for the restart after the vacation, and the re-rolled steel departments, also, are more active. Prices are all unchanged.

### Coal.

The collieries in all districts have had enough to do to attend to existing orders without paying much attention to fresh inquiries. A few small commitments for January and early February have been mentioned, but the owners as a rule are not prepared to do any more forward business at present. Home deliveries to general utility works have been heavier owing to the holidays, while the demand for household fuel has been most insistent.

### Lanarkshire Miners' Wages Increase.

As a result of the joint accountants' ascertainment of the output for September and October, it is anticipated that the Lanarkshire miners' wages for January and February, 1924, will show an advance of 4¼d. per day. The normal wage in the county will thus be raised to 9s. 10¼d. per day.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

### Coal Trade Conditions.

Business has scarcely settled down after the holidays, and it will be next week before the real position can be accurately gauged. The miners resumed after their Christmas vacation in good numbers, and there is no doubt that by the end of this week satisfactory outputs will be forthcoming. On Monday last it was reported that there were thirty-one steamers on the waiting list at the various docks in this district, so that it cannot be said that there was any shortage of ready tonnage, though this may have been the case with some of the collieries. Up to now coals have been none too plentiful to meet the requirements of the steamers to hand, and small coals especially have been scarce and are likely to continue to be so for some time. Most exporters had made their cargo arrangements prior to the holidays for any steamers which they expected to arrive over the holidays, so that since then there has not been very much activity on the market. Furthermore, it has not been the experience of exporters that they have returned to business to find much fresh continental inquiry for coals for this month's shipment. On the other hand, it has transpired that credits have been established in this country by the German Government for three-quarters of a million sterling for the purchase of 400,000 tons of coal from the Midlands and the Northern coalfields, these coals being for the German State Railways. Unfortunately, it is considered that the prices for South Wales coals are too high, so that it is unlikely that any substantial amount of German business will come to this district unless there is a material alteration in the state of this market for the worse. On the other hand, although the tendency of prices is somewhat in a downward direction, the possibility is that the placing of German orders in the North will reflect upon this market and help to steady the conditions here.

### The Third Shift.

In view of the fact that the temporary period for the working of the partial third shift expired at the end of this week, the representatives of the employers and the tippers and trimmers have had a busy time during the past week or so in their negotiations and efforts to arrive at an understanding for the continuance of the shift. On Tuesday the Court of Inquiry appointed by the Ministry of Labour met the representatives of the workmen and the employers as a Conciliation Committee, and the Court expressed the opinion that in the interest of all concerned in the trade of South Wales, the partial third shift should be continued, and that the committee established at each port under the agreement of May 12th last should forthwith consider any suggestions from either side for the furtherance of the work and the promotion of efficiency, including the question of the number of appliances to be worked. The Court further announced that it was, however, impressed by the fact that the financial position of the tippers had been adversely affected by the introduction of the third shift, and the Court considered that a conference should forthwith take place between the railway company and the tippers' representatives with a view to the adjustment of this question. The Court was not unanimous that the same case had been made out by the trimmers, and recommended that any claim that they might desire to put forward should be submitted to the South Wales Area Board and, if necessary, to the National Trimming Board. The Court suggested that the agreement to continue the partial third shift, without prejudice to any question involved, be extended to Saturday, 19th inst., in order that the conferences respecting the tippers and trimmers respectively might be held with a view to effecting a settlement in the meantime. The Court was thereupon adjourned until the 15th inst. Subsequently the representatives of the tippers and coal trimmers met and decided to recommend the men to continue the working of the partial third shift until the 19th inst., thus giving their negotiators an opportunity of making an agreement which will give effect to the resolution of May last, protecting the earning power of both sections of the workmen concerned. It is probable that there will be mass meetings of the men to consider the position shortly.

### The Tin-plate Trade.

The demand from all quarters, including even America, for tin-plates from South Wales continues to be good and in excess of supply, so that provided there is no sudden upheaval such as labour disturbance the view is held that the prospects for the trade are very bright. A question concerning the trade which has caused some discussion of late is that of the establishment of a central selling agency, and this has arisen consequent upon the centralisation of the sales agencies of Richard Thomas and Co., Limited, and the Grovesend Tin-plate Company, and a few other South Wales tin-plate undertakings. The new company in which merchant firms will be interested will have a nominal capital of £1,000,000, of which £550,000 will be subscribed at once by the works taking part in the scheme. It is stated that the number of works controlled by it will be 228 with an annual production of nine and a-half million boxes. From what can be gathered the merchants generally do not appear to be perturbed by the development regarding the proposed central selling agency, although it is acknowledged that the agency will control about 60 per cent. of the trade and doubtless will endeavour to secure the inclusion in time of the other 40 per cent.

### Current Business.

The tone of the market remains quiet and steady. Very little business has been done since the holidays. The shortage of small coals is felt most, and for the time being the market for these qualities is firm; but so far as large coals are concerned, it is fully expected that by the middle of this month there will be an easing down in values owing to the lack of the fresh demand coming along and the prospect of outputs of coal being fairly heavy. At the same time some of the leading collieries are, according to their books, well sold for the whole of this month, and this is partly due to the fact that owing to the extreme pressure prevailing during the first three weeks of last month the collieries agreed with some of their contractors to carry forward supplies of their contract coal to the current month. On the whole, it cannot be said at the moment that there is very much change in quotations as compared with those obtainable immediately before the holidays, but there is a feeling that later in the month values will be weaker to some extent.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. COAST— | |
| Native | 19/6 to 26/- |
| (1) Spanish | 23/- |
| (1) N. African | 23/- |
| N.E. COAST— | |
| Native | — |
| Foreign (c.i.f.) | 25/- |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) SCOTLAND— | | |
| Hematite | 5 8 9 | — |
| No. 1 Foundry | 5 11 3 | — |
| No. 3 Foundry | 5 6 3 | — |
| N.E. COAST— | | |
| Hematite Mixed Nos. | 5 2 6 | 5 2 6 |
| No. 1 | 5 3 6 | 5 3 6 |
| Cleveland— | | |
| No. 1 | 5 6 6 | 5 6 6 |
| Silicious Iron | 5 6 6 | 5 6 6 |
| No. 3 G.M.B. | 5 0 0 | 5 0 0 |
| No. 4 Foundry | 4 17 6 | 4 17 6 |
| No. 4 Forge | 4 16 6 | 4 16 6 |
| Mottled | — | — |
| White | — | — |
| MIDLANDS— | | |
| (3) Staffs.— | | |
| All-mine (Cold Blast) | 9 2 6 | |
| North Staffs. Forge | 4 10 0 | |
| ,, ,, Foundry | 4 15 0 to 5 0 0 | |
| (3) Northampton— | | |
| Foundry No. 3 | 4 13 6 | — |
| ,, Forge | 4 7 6 | — |
| (3) Derbyshire— | | |
| No. 3 Foundry | 4 15 0 to 4 16 6 | — |
| Forge | 4 9 0 to 4 10 0 | — |
| (3) Lincolnshire— | | |
| No. 3 Foundry | 4 15 6 | — |
| No. 4 Forge | 4 14 0 | — |
| Basic | 4 15 0 | — |
| (4) N.W. COAST— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 5 15 0 (a) / 6 0 0 (b) | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| SCOTLAND— | | |
| Crown Bars | 12 10 0 | — |
| Best ,, | — | — |
| N.E. COAST— | | |
| Crown Bars | 12 0 0 | — |
| Tees | 10 0 0 | — |
| LANCS.— | | |
| Crown Bars | 12 10 0 | — |
| Second Quality Bars | 11 15 0 | — |
| Hoops | 15 0 0 | 14 15 0 |
| S. YORKS.— | | |
| Crown Bars | 12 10 0 | — |
| Best ,, | 13 10 0 | — |
| Hoops | 14 10 0 | — |
| MIDLANDS— | | |
| Crown Bars | 12 10 0 | — |
| Marked Bars (Staffs.) | 14 10 0 | — |
| Nut and Bolt Bars | 11 0 0 | — |
| Gas Tube Strip | 12 10 0 to 12 15 0 | |

## STEEL.

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) SCOTLAND— | | |
| Boiler Plates | 13 10 0 | — |
| Ship Plates, ¾in. and up | 10 5 0 | — |
| Sections | 10 0 0 | — |
| Steel Sheets, 3/16in. to ¼in. | 12 10 0 | — |
| Sheets (Gal. Cor. 24 B.G.) | — | 19 0 0 |

## STEEL (*continued*).

| N.E. COAST— | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| Ship Plates | 10 5 0 | — |
| Angles | 10 0 0 | — |
| Boiler Plates | 13 0 0 | — |
| Joists | 10 0 0 | — |
| Heavy Rails | 9 10 0 | — |
| Fish-plates | 13 0 0 | — |
| Channels | 9 5 0 | — |
| Hard Billets | 10 5 0 | — |
| Soft Billets | 9 0 0 | — |
| N.W. COAST— | | |
| BARROW— | | |
| Heavy Rails | 9 5 0† | — |
| Light ,, | 9 10 0 to 10 0 0† | — |
| Billets | 8 10 0 to 12 0 0† | — |
| Hoops | 14 10 0 | — |
| MANCHESTER— | | |
| Bars (Round) | 10 10 0 to 10 15 0 | |
| ,, (others) | 10 5 0 to 10 7 6 | |
| Hoops (Best) | 15 5 0 | 15 0 0 |
| ,, (Soft Steel) | 13 15 0 | 13 10 0 |
| Plates | 10 10 0 | — |
| ,, (Lancs. Boiler) | 13 10 0 | — |
| SHEFFIELD— | | |
| Siemens Acid Billets | 12 10 0 | |
| Bessemer Billets | 13 0 0 | |
| Hard Basic | 10 5 0 | |
| Intermediate Basic | 10 0 0 | |
| Soft Basic | 9 0 0 | — |
| Hoops | 12 10 0 to 13 0 0 | |
| Soft Wire Rods | 11 10 0 | |
| MIDLANDS— | | |
| Small Rolled Bars | 10 15 0 to 11 0 0 | |
| Billets and Sheet-bars | 8 7 6 to 8 15 0 | |
| Gas Tube Strip | 10 15 0 to 11 0 0 | |
| Sheets (20 W.G.) | 11 10 0 to 12 0 0 | |
| Galv. Sheets, f.o.b. L'pool | 18 15 0 to 19 0 0 | |
| Angles | 10 0 0 | |
| Joists | 10 0 0 | |
| Tees | 11 0 0 | |
| Bridge and Tank Plates | 10 10 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| SWANSEA— | |
| Tin-plates, I.C., 20 by 14 | 24/- to 24/3 |
| Block Tin (cash) | 234 5 0 |
| ,, (three months) | 236 5 0 |
| Copper (cash) | 62 7 6 |
| ,, (three months) | 63 2 6 |
| Spanish Lead (cash) | 31 5 0 |
| ,, (three months) | 31 7 6 |
| Spelter (cash) | 32 11 3 |
| ,, (three months) | 32 16 3 |
| MANCHESTER— | |
| Copper, Best Selected Ingots | 66 10 0 |
| ,, Electrolytic | 68 0 0 |
| ,, Strong Sheets | 95 0 0 |
| ,, Tubes (Basis price) | 0 1 1½ |
| Brass Tubes (Basis price) | 0 1 0 |
| ,, Condenser | 0 1 2½ |
| Lead, English | 32 10 0 |
| ,, Foreign | 31 0 0 |

## FERRO ALLOYS.

*(All prices now nominal.)*

| | Per Ton. | Per Unit. |
|---|---|---|
| Tungsten Metal Powder | 1/9 per lb. | |
| Ferro Tungsten | 1/5 per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £23 0 0 | 10/6 |
| ,, 6 p.c. to 8 p.c. ,, | £22 0 0 | 8/- |
| ,, 8 p.c. to 10 p.c. ,, | £21 0 0 | 8/- |
| ,, Specially Refined | | |
| ,, Max. 2 p.c. carbon | £50 0 0 | 18/- |
| ,, ,, 1 p.c. ,, | £60 0 0 | 21/- |
| ,, ,, 0.75 p.c. carbon | £65 0 0 | 22/6 |
| ,, carbon free | 7/6 per lb. | |
| Metallic Chromium | 4/- per lb. | |
| Ferro Manganese (per ton) | £18 for home, £20 for export | |
| ,, Silicon, 45 p.c. to 50 p.c. | £11 10 0 scale 5/- per unit | |
| ,, ,, 75 p.c. | £18 0 0 scale 6/- per unit | |
| ,, Vanadium | 19/- per lb. | |
| ,, Molybdenum | 9/- per lb. | |
| ,, Titanium (carbon free) | 1/2 per lb. | |
| Nickel (per ton) | £130 | |
| Cobalt | 11/- per lb. | |
| Aluminium (per ton) | £82 to £100 (British Official.) | |

## FUELS.

### SCOTLAND.

| LANARKSHIRE— | Export. |
|---|---|
| (f.o.b. Glasgow)—Steam | 24/- |
| ,, ,, Ell | 25/- |
| ,, ,, Splint | 25/6 to 28/6 |
| ,, ,, Trebles | 25/- |
| ,, ,, Doubles | 23/6 |
| ,, ,, Singles | 21/6 |
| AYRSHIRE— | |
| (f.o.b. Ports)—Steam | 24/- |
| ,, ,, Splint | 25/6 |
| ,, ,, Trebles | 25/- |
| FIFESHIRE— | |
| (f.o.b. Methil or Burntisland)—Steam | 22/- to 23/9 |
| Screened Navigation | 28/- |
| Trebles | 26/- to 27/- |
| Doubles | 23/6 |
| Singles | 21/6 |
| LOTHIANS— | |
| (f.o.b. Leith)—Best Steam | 24/- |
| Secondary Steam | 23/- |
| Trebles | 25/3 |
| Doubles | 23/6 |
| Singles | 21/6 |

### ENGLAND.

| | |
|---|---|
| (8) N.W. COAST— | |
| Steams | 29/- |
| Household | 48/- to 59/- |
| Coke | 43/6 |
| NORTHUMBERLAND— | |
| Best Steams | 24/3 to 25/6 |
| Second Steams | 21/6 to 23/- |
| Steam Smalls | 14/6 to 16/- |
| Unscreened | 20/6 |
| Household | 25/- to 28/- |
| DURHAM— | |
| Best Gas | 24/- to 25/- |
| Second | 23/- to 23/6 |
| Household | 25/- to 28/- |
| Foundry Coke | 50/- |

| SHEFFIELD— | Inland. | |
|---|---|---|
| Best Hand-picked Branch | 33/- to 34/- | — |
| Barnsley Best Silkstone | 27/6 to 29/- | — |
| Derbyshire Best Brights | 27/- to 29/- | — |
| ,, ,, House | 23/- to 24/- | — |
| ,, ,, Large Nuts | 22/- to 23/6 | — |
| ,, ,, Small ,, | 17/6 to 19/6 | — |
| Yorkshire Hards | 22/- to 23/6 | — |
| Derbyshire ,, | 21/- to 22/6 | — |
| Rough Slacks | 12/6 to 13/6 | — |
| Nutty ,, | 10/- to 12/- | — |
| Smalls | 5/- to 8/- | — |
| Blast-furnace Coke (Inland) | 26/6 to 27/6 | |
| ,, ,, (Export) | f.o.b. 32/- to 33/- | |

### (9) SOUTH WALES.

| CARDIFF— | |
|---|---|
| Steam Coals: | |
| Best Smokeless Large | 29/- to 30/- |
| Second ,, ,, | 28/- to 29/- |
| Best Dry Large | 27/- to 28/- |
| Ordinary Dry Large | 26/- to 27/- |
| Best Black Vein Large | 28/6 to 29/- |
| Western Valley ,, | 27/6 to 28/6 |
| Best Eastern Valley Large | 27/6 to 28/6 |
| Ordinary ,, ,, | 26/- to 27/- |
| Best Steam Smalls | 21/- to 22/- |
| Ordinary ,, | 18/- to 21/- |
| Washed Nuts | 28/- to 30/- |
| No. 3 Rhondda Large | 28/- to 29/- |
| ,, ,, Smalls | 25/- to 26/- |
| No. 2 ,, Large | 25/- to 26/- |
| ,, ,, Through | 20/- to 22/- |
| ,, ,, Smalls | 19/- to 20/- |
| Coke (export) | 55/- to 60/- |
| Patent Fuel | 30/- to 32/6 |
| Pitwood (ex ship) | 29/6 to 30/- |
| SWANSEA— | |
| Anthracite Coals: | |
| Best Big Vein Large | 40/- to 45/- |
| Seconds | 34/- to 36/- |
| Red Vein | 32/- to 33/- |
| Machine-made Cobbles | 52/6 to 55/- |
| Nuts | 55/- to 60/- |
| Beans | 42/6 to 45/- |
| Peas | 26/- to 27/- |
| Breaker Duff | 12/9 to 13/- |
| Rubbly Culm | 13/6 to 14/- |
| Steam Coals: | |
| Large | 24/- to 25/- |
| Seconds | 22/- to 23/- |
| Smalls | 14/- to 16/- |
| Cargo Through | 19/- to 21/- |

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

† Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

# French Engineering Notes.

(*From our Correspondent in Paris.*)

### Trade Prospects.

WHILE the engineering trades have been marking time at the end of the year, there is, nevertheless, a large number of contracts for public works and railway rolling stock, and the situation would appear to be relatively satisfactory if it were not for the uncertainty that exists over the future prices of iron and steel. In many directions there are evidences of improvement. Additional furnaces have been put in blast, and the metallurgical production is steadily increasing; but despite the larger consignments of coke from the Ruhr there is not likely to be any reduction in prices before the end of February. The basis price for coke is still 220f. French coal has advanced, and British fuel has considerably increased with the further depreciation of the franc. There appears, therefore, to be little hope of easier iron and steel prices for the time being, and this creates a certain perplexity from the fact that the home demand cannot absorb much more than one-half of the country's maximum production, so that makers must either find outlets abroad or there will be a keen competition on the home market.

### Shipbuilding.

The inability of the shipbuilding industry to recover from the slump that has been hanging over it for some years past is now attributed, curiously enough, to the competition of British shipyards, and it is suggested that some drastic measures will have to be taken if the industry is not to fall into a permanent decline. There is so little being done in home shipbuilding that the only hope of the yards finding employment is to secure orders abroad; but they are unable to enter the lists for competitive work on account of the cost of transporting plates and other materials from the centres of production, while the prices have been considerably increased by the extraordinary inflation in the cost of coke. Special advantages are accorded to shipbuilders in freight reductions on material, but they are quite inadequate to allow of their competing for foreign business, and owing to the long distances over which the material has to be transported it is suggested that shipbuilders should be allowed to import British plates free of duty for the execution of foreign orders. These suggestions, however, offer no real solution of a very serious difficulty, which can only be overcome when there is an abundance of cheap material.

### Tidal Power.

The scheme for the construction of a tidal power station at Aber Wrac'h, in Brittany, for which credits were voted by the Chamber of Deputies nearly a year ago, has now been approved of by the Senate, and will, therefore, probably be put in hand at an early date. The idea is to create a station on a sufficiently large scale to allow of valuable experience being acquired as to the conditions under which the energy produced by the tides can be utilised to the best advantage, at the same time that the production of current for distribution to Brest will enable the enterprise to pay its way. The scheme provides for the construction of a barrage 150 m. long, with four groups of alternators driven by turbines that reverse on the ebb tide and develop from 75 to 1200 horse-power, according to the head. The variations of output will be adjusted by another station, which will utilise a constant head of water from the river Diouris that flows into the Aber Wrac'h estuary. The two together will provide a minimum of 1600 horse-power and a maximum of 3200 horse-power. It is not considered prudent to depend entirely upon tidal power for this first attempt, which will, nevertheless, allow of experiments being carried out to determine the most suitable equipments for the purpose, and when sufficient knowledge and experience have been acquired of the best way of utilising the tides concessions will be granted for installations elsewhere, notably at the outlet of the Rance, where the conditions appear to be particularly favourable.

### The Seine Floods.

The Seine has been rising at a more rapid rate than at the time of the disastrous flood in January, 1910, and it is already higher than at any period since then. Although there may be no reason to fear a recurrence of the danger to Paris, in view of the works that have been carried out to prevent it, the possibility of serious inundations is, nevertheless, causing a good deal of uneasiness, and many of the factories near the river outside the city have either had to stop work or preparations are being made to vacate them in the event of the water level rising still further. The raising of the embankments and the closing of the sewers and other outlets into the river have attenuated the danger in Paris, but they do not prevent infiltration, and the populous suburbs can only be saved from floods by deepening the Seine or constructing vast reservoirs, such as have been proposed, for regulating the water level. So great is the alarm at the present moment that the Municipal Council will doubtless make strenuous efforts to accelerate the carrying out of the programme for the deepening of the Seine to Rouen, in pursuance of the scheme for converting Paris into a seaport.

### Paris Extensions.

As Paris is unable to grow upwards, it is obliged to spread outwards, and among the many projects which the Municipal Council has in hand for solving the housing problem is the creation of a garden city on a site of about 1800 acres at Corneneuve, one of the northern suburbs. A competition is opened to French designers for the laying out of a city on the most modern and approved lines, and should the experiment prove successful, similar cities will be laid out elsewhere, chiefly for the benefit of the working classes.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

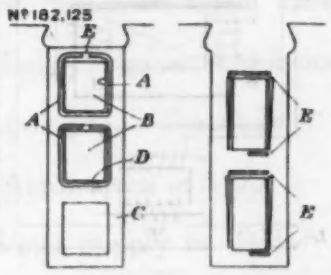
*Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## DYNAMOS AND MOTORS.

182,125. June 23rd, 1922.—IMPROVEMENTS IN DEVICES FOR PROTECTING CONDUCTORS OF ELECTRIC MACHINES AGAINST LOSSES DUE TO EDDY CURRENTS, Théodore Lehmann, of Urmatt (Bas-Rhin), France.

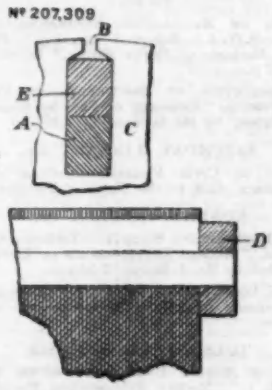
This invention relates to arrangements for reducing the additional losses due to eddy currents in the conductors of electric machines. It is well known that nearly all these losses are due to the portion of the conductor which is embedded in the slot, so that by protecting this portion of the conductor against the




magnetic field in the slot, and more particularly at the outer end of the slot, the additional losses may be reduced. According to this invention the outer conductors are protected by shields A extending completely around the conductors B, which are embedded in the insulation C of the slot and separated from the conductor by an insulating layer D of paper, which is lacquered. As will be seen in the drawing, the shield is separated from the walls of the slot by the insulation C. In the top of the shield is provided an air gap E.—*November 23rd*, 1923.

207,309. September 22nd, 1922.—IMPROVEMENTS IN AND RELATING TO ALTERNATING ELECTRIC CURRENT MOTORS, *The British Thomson-Houston Company, Limited, Crown House, Aldwych, London, W.C. 2.*

This invention relates to alternating-current motors and more particularly to alternating motors provided with one or more squirrel-cage windings on their rotor elements. Various expedients have been resorted to in the construction of squirrel-cage rotors both in the synchronous and asynchronous types of motors, with a view to obtaining the most desirable starting and operating characteristics. It is the object of this invention to improve the mechanical construction of the rotor element of such motors without sacrificing to any extent the desirable starting and operating characteristics found in commercial alternating-current motors. The improvements in mechanical

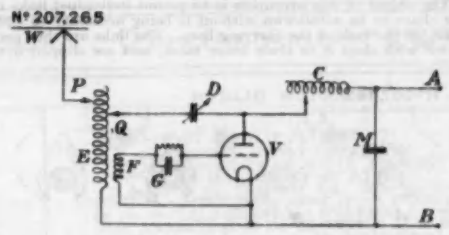



design contemplated by the present application include the simplest possible mechanical construction which will permit of a wide variation in the electrical constants of the squirrel-cage with a slot of standard dimensions. Rectangular squirrel-cage bars A are placed in the bottom of straight edge rectangular slots B punched in the laminations C and having overhanging retaining laminations at the periphery. The squirrel-cage bars are connected to end rings, one of which is shown at D in any well-known manner. Above the squirrel-cage bars there are placed rectangular bars E of magnetic material, preferably steel. These bars lie on top of the squirrel-cage bars and completely fill up the space between the squirrel cage and the narrow openings of the slots. The steel bars E are prevented from working out endwise by the end rings D, which are of sufficient depth to form retaining rings for the steel bars E.—*November 29th*, 1923.

## TELEGRAPHS AND TELEPHONES.

207,265. August 24th, 1922.—IMPROVEMENTS IN AND RELATING TO WIRELESS TRANSMISSION BY THERMIONIC VACUUM TUBES, Lionel George Preston, George Shearing, and Ernest James Grainger, all of H.M. Signal School, Royal Naval Barracks, Portsmouth.

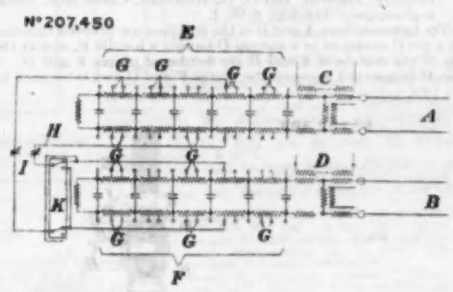
The object of this invention is to arrange a valve transmission circuit of a simple and efficient form, particularly applicable for efficient working at long wave lengths, say, of the order of 6000 m. or more. The high-tension supply, which may be direct or alternating and applied across the terminals A B of the condenser M, is applied to the anode of the transmitting valve V *vid* the inductance C, which is adjustable and of high efficiency, and to the aerial circuit *vid* the inductance C and condenser D, the condenser also being adjustable and of high efficiency. It is found that if the condenser D and coil C are adjusted to a certain value depending on the wave length of the required transmission in the aerial circuit comprised in the inductance E P and aerial W, a very efficient transmitting arrangement is obtained, especially on long wave lengths. The coil C can be adjusted to be such a value that the condenser D required may be very small. As an example, the capacity of the condenser D need only be of the order of 1000 cm. or less for a wave length of 10,000 m. for very efficient operation. The best conditions are obtained when the condenser D and coil C are so adjusted




that the circuit comprising the condensers D and M and inductances C and E between the tapping Q and earth are in resonance with the aerial circuit. In practice the capacity M is large relative to capacity D, and inductance E small relative to inductance C, so that the practical best condition is when the product of the inductance C and capacity D is approximately equal to that of the aerial oscillatory circuit. A coupling coil F for the grid circuit of the valve V and a grid leak G are shown.—*November 26th*, 1923.

207,450. March 7th, 1923.—IMPROVEMENTS IN OR RELATING TO LONG-DISTANCE TELEPHONY, Bertram Edward Dunbar of Chancery-lane Station Chambers, 31–33, High Holborn, London, W.C. 1.

This invention relates to a system of long-distance telephony employing conductor pairs arranged in groups, and has more particular reference to a method of reducing cross communication between such conductor pairs. An arrangement of connections according to the invention is illustrated in the accompanying drawing. It will be assumed that two long-distance conductor pairs only are used lying in the same cable. These conductor pairs are designated by A and B. Artificial conductors E and F, consisting of resistance coils and condensers, are connected to the conductors A and B through the known transformer arrangements C and D, which lead to the sending and receiving apparatus. The artificial conductors E and F are made as far as possible identical as regards their resistance and capacity per unit length with the real conductors A and B. The self-induction and the leakage would be represented in the artificial conductors by small choke coils and bridge resistances. The artificial conductors are provided with a number of tappings having terminals G, to which the couplings can be connected.

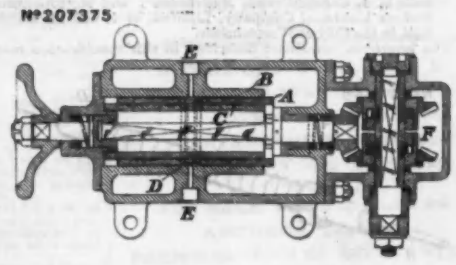



Assuming that the coupling between the two long-distance conductors A and B by which cross communication is set up is of electrostatic (*i.e.*, capacitative) form, an electrostatic coupling consisting of variable rotary condensers H I is then connected to suitable terminals G G. It may happen that the coupling has been applied in the right sense, that is, so that the cross communication on the real conductors A B is nullified as regards the receiving apparatus by a corresponding cross communication between the artificial conductors E and F, or, on the other hand, the coupling may be in the wrong sense, that is, so that the two effects are added in the receiving apparatus. In the latter case the reversing switch K must be operated so as to bring the coupling into the correct sense. Apart from this question of reversal, three investigations must be made: first, as to the type of coupling between the real conductors A and B; secondly, as to the correct point of connection of the coupling to the artificial conductors; and thirdly, as to the correct magnitude of the coupling elements. These can be found only by trial and error, and for this purpose it is necessary to provide a large number of terminals G G. In the case of a resistive coupling its composition is investigated by connecting a direct-current source up to one conductor A and a mirror galvanometer to the other conductor B.—*November 29th*, 1923.

## PUMPING AND BLOWING MACHINERY.

207,375. November 23rd, 1922.—SCREW PUMPS FOR VISCOUS FLUIDS, Sir J. Dewrance, 165, Great Dover-street, Southwark.

This lubricating pump is of the screw type. That is to say, the oil is driven forward by the action of a screw rotating inside a plain cylinder. The screw thread is cut right and left-handed



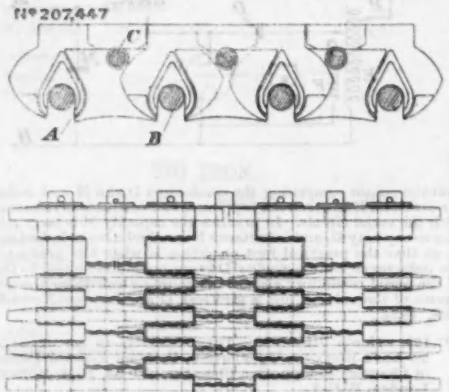

on opposite ends of the sleeve A, which is rotated inside the plain cylindrical casing B. Inside the sleeve A there is another, fixed, sleeve C which is also threaded, and thus forms another pumping element. The oil enters at the outer ends of the threads and is delivered at the centre to a segmental recess D in the sleeve A. As this recess passes openings E E oil is delivered to the parts requiring lubrication. A hand wheel is provided for

rotating the pump, while the bevel pinion and clutch gear F is used for driving it from a reciprocating part of the engine.—*November 29th*, 1923.

## FURNACES.

207,447. March 7th, 1923.—CHAIN GRATE STOKERS, Babcock and Wilcox, Limited, Oriel House, Farringdon-street, London.

The object of this invention is to permit individual links of the chain to be withdrawn without it being necessary to slide them off the ends of the carrying bars. The links are thus provided with slots A in their lower faces, and are slipped over

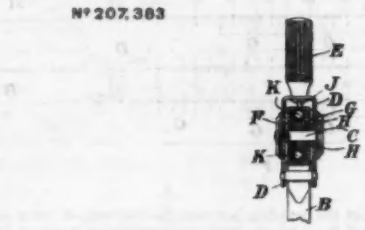


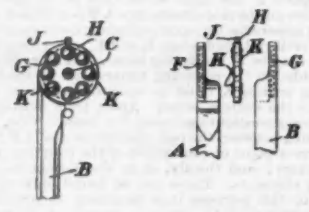

carrying bars B of the chain. In order to support the bars as they travel, upside down, back to the front of the furnace, locking rods C are threaded through holes near the top of the bars. These rods C interlock the bars, but when they are withdrawn and the grate is passing over the front roller, so that the spacing is opened out, any individual bar can be removed without breaking the continuity of the chain.—*November 29th*, 1923

## MEASURING AND TESTING INSTRUMENTS.

207,383. December 5th, 1922.—COMPASS PIVOTS, Norton and Gregory, Limited, and G. G. Hickman, Castle-lane, Buckingham-gate, London, S.W. 1.

The two members A and B of the compass are pivoted together by a pin C mounted in a stirrup D having a handle E, and at the top of the members A and B are hardened plates F and G. A disc H is inserted between the plates F and G and is secured by



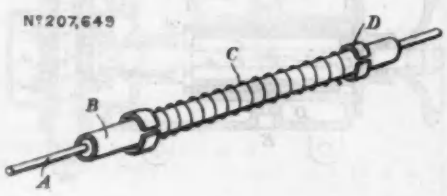




a projection J, which fits into a recess in the handle E. In the disc H are a number of holes, into which a number of balls K are inserted, the balls being of such a diameter that when the parts are assembled they make contact with the plates F and G. When either of the members A or B is moved, the other member is frictionally driven through the same angle by the rotation of the balls K.—*November 29th*, 1923.

## MISCELLANEOUS.

207,649. September 18th, 1922.—IMPROVEMENTS IN ELECTRICAL CONDENSERS AND THE LIKE, Walter John Brown, of Eversley, Davenport Park, Stockport; Hugh Glover Bell, of 4, Chelford-road, Manchester; and Metropolitan-Vickers Electrical Company, Limited, of 4, Central Buildings, in the City of Westminster.

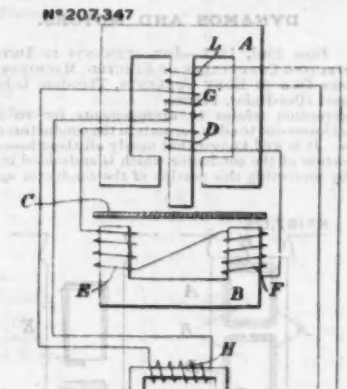
The improved condenser described in this specification may




be employed for screening conductors from the effect of or preventing them from affecting neighbouring conductors. One instance where such an application is of particular use is in the construction of radio frequency amplifiers. The conductor A has an insulating covering B, which may be one of the usual coverings used for insulating electrical cables, or it may consist of a braiding or sleeving of insulating material which is slipped over the conductor. The helix C—in this case of wire—is threaded over the insulating covering B and is held at both ends by means of clips D which secure the helix to the insulating covering.—*December 6th*, 1923.

207,347. October 21st, 1922.—IMPROVEMENTS RELATING TO ELECTRIC RELAYS, Thomas Wylie Ross, of 38, Longford-avenue, Stretford, Manchester, and Metropolitan-Vickers Electrical Company, Limited, of 4, Central-buildings, Westminster.

This invention relates to electric relays and in particular to relays of the kind provided with a locknut or retaining coil which prevents the operation of the relay when a current exceeding a predetermined limit is passing through the circuit which is to be protected. In the drawings the relay comprises a magnetisable core A, which co-operates with a magnetisable core B for




revolving a disc C which is adapted to open or close the circuit of the actuating coil of the circuit breaker. Shaded poles having a coil D, are provided, the coil being connected in series with the energising coils E and F for the magnetisable core B in the usual manner. The main operating coil G of the relay is connected in series with the secondary winding H of a saturable transformer K, and the opposing winding L is connected in series with the primary winding M of the transformer K across the terminals L of the relay. The relay terminals L may be connected to the secondary winding of a current transformer (not shown) provided in the circuit which it is desired to protect. The operation of the relay is fully described.—*November 29th*, 1923.

# Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### TO-DAY.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, S.W. 1. Informal meeting. Discussion on "Mechanical Methods of Boiler Firing," introduced by Mr. H. P. Gaze. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Economy of Fuel by Removal of Soot from Boiler Tubes," by Mr. L. Manico. 7.30 p.m.

### SATURDAY, JANUARY 5TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street S.W. 1. Students' visit to the National Physical Laboratory

### MONDAY, JANUARY 7TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lecture, "Modern Developments in Electrical Driving of Textile Mills," by Mr. J. Shaw. 7.30 p.m.

SURVEYORS' INSTITUTION.—12, Great George-street, S.W. 1. Paper, "Economics of Estate Management," by Mr. D. T. Thring. 8 p.m.

### TUESDAY, JANUARY 8TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, E. 1. "Modern Refrigerating Machines," by Mr. R. G. Reid. 6.30 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street, Birmingham. Paper, "Nickel Brasses," by Mr. O. Smalley. 7 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Theatre, Armstrong College, Newcastle-on-Tyne. Paper, "The Action of Molten Brass on Nickel Steel," by Mr. H. M. Duncan. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry graduates' meeting. Paper, "Aero Influence in Automobile Practice," by Mr. R. W. Day. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Paper, "An Account of an Examination of the Menai Suspension Bridge," by Messrs. H. T. Tudsbery and A. R. Gibbs. 6 p.m.

INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-ON-TYNE ASSOCIATION.—Neville Hall, Newcastle-upon-Tyne. First Vernon Harcourt Lecture, "River Training and Maintenance Work," by Mr. R. F. Hindmarsh. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, King-street, Leeds. "Life and Work of Lord Kelvin," by the President, Dr. Alexander Russell. 7.15 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Papers, "The Crude Oil of Sarawak," by Mr. James Kewley, and "The Crude Oil of Maidan-i-naftun," by Dr. A. E. Dunstan. 5.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Cannon Street Hotel, E.C. 4. Dance. 7 p.m.

### WEDNESDAY, JANUARY 9TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Paper, "Water-cooled Aero-engines," by Mr. A. J. Rowledge. 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Students' meeting. Lecture, "The Work of a Constructional Engineer's Office," by Mr. J. M. Moncrieff. 6 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—The Engineers' Club, Coventry-street, W. 1. Lecture, "A New Universal Regulator for the Control of Temperature, Pressure, Humidity, &c." by Mr. T. Lindsay. 7 p.m.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Paper, "Transient Track Circuits," by Mr. E. A. Hudd. 6.30 p.m.

### THURSDAY, JANUARY 10TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Institute of Marine Engineers, 85/88, The Minories, E. 1. Paper, "X-rays and Metallurgy," by Mr. W. T. Griffiths. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Works of Vauxhall Motors, Limited, Kimpton-road, Luton. Luton graduates' meeting. Paper, "Four-wheel Braking," by Mr. A. C. Saward. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Joint meeting with the Société des Ingenieurs Civils de France (British Section). Continued discussion on "The Electrification of the Midi Railway," by Monsieur A Bachellery. 6 p.m.

### FRIDAY, JANUARY 11TH.

BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION.—Connaught Rooms, Great Queen-street, W.C. 2. Annual luncheon.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Albany Hotel, Fargate, Sheffield. Joint meeting with the Institution of British Foundrymen. Paper, "Influence of Casting Temperature on the Physical Properties of Metals." by Mr. F. H. Hurren. 7.45 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, S.W. 1. Informal meeting. Demonstration of cinematograph films illustrating "The Construction of an Aero Engine," and other subjects. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Paper, "Concrete Engineering," by Mr. C. O. Mourant. 7.30 p.m.

### MONDAY, JANUARY 14TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Queen's Hotel, Birmingham. Informal meeting. 6.15 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Open discussion. 7.30 p.m.

### TUESDAY, JANUARY 15TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, E. 1. Adjourned discussion on "Superheating." 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND STUDENTS' SECTION.—The University, Leeds. "Switching Transients," by Mr. W. S. Stuart. 7 p.m.

### WEDNESDAY, JANUARY 16TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Birmingham graduates' meeting. Paper, "Advertising Systems," by Mr. A. W. Allister. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Star and Garter Hotel, Wolverhampton. Discussion on "Repairs," to be opened by Mr. A. E. Jones. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Presidential address, "Marine Propulsion during Fifty Years," by Sir J. Fortescue Flannery. 7.30 p.m.

### THURSDAY, JANUARY 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House Adelphi, W.C. 1. London graduates' meeting. Paper, "Inspection," by Mr. E. Varian. 7.30 p.m.

### FRIDAY, JANUARY 18TH.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. Paper, "The Annealing of Non-ferrous Metals," by Captain L. Taverner. 7.15 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—College of Technology, Sackville-street, Manchester. Ordinary general meeting. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "The Liability of Employers in Respect of Personal Injuries to their Workmen," by Mr. G. F. Tyler. 7.30 p.m.

### FRIDAY, JANUARY 25TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Holborn Restaurant, W.C. 1. South-Eastern District dinner. 6.30 p.m.

### FRIDAY, FEBRUARY 1ST.

UNIVERSITY COLLEGE, LONDON, ENGINEERING SOCIETY.—The College Refectory, Gower-street, W.C. 1. Annual Dinner and Conversazione.

# CALENDARS, DIARIES, &c.

CARRON COMPANY, Carron, Falkirk.—Showcard illustrating Carron haulage gears.

H. W. WARD AND CO., Limited, Birmingham.—Wall calendar with monthly tear-off sheets.

JOHN TULLIS AND SON, Limited, St. Ann's Works, Glasgow.—Wall calendar with daily tear-off sheets.

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WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 2, Norfolk-street, Strand, W.C. 2.—Pocket diary containing useful information.

HENRY SIMON, Limited, 20, Mount-street, Manchester.—Copy of this firm's standard yearly calendar with daily tear-off sheets.

HART ACCUMULATOR COMPANY, Limited, Marshgate-lane, Stratford, E. 15.—Desk calendar and blotter. Wall calendar with monthly tear-off sheets.

HASLAM AND STRETTON (ENGINEERING AND MOTOR UTILITIES), Limited, Cardiff, Bristol, and Swansea.—Wall calendar. Picture of "Joan" in offset process, with monthly tear-off slips.